



2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed



December 2003



Commonwealth of Massachusetts

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ABSTRACT

The Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management (and its predecessor, the Metropolitan District Commission, Division of Watershed Management) has been aggressively implementing and expanding its watershed programs in the Wachusett Reservoir watershed since the initial Watershed Protection Plan was published in 1991. The *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* continues this trend of identifying key issues and setting priorities for the DCR Bureau of Watershed Management. This Plan Update:

- Documents the recommendations of the 1998 Wachusett Reservoir Watershed Protection Plan Update that have been completed.
- Incorporates increased knowledge of the watershed and water quality.
- Assesses the current "state of the watershed."
- Formally states goals and five-year objectives for each program area.
- Establishes a schedule of activities for the next five years.

Acknowledgements:

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Unless noted otherwise, all black & white historic photographs are provided courtesy of the Massachusetts State Archives. All other photographs provided by the Bureau of Watershed Management.

All maps were produced by DCR/DWSP Bureau of Watershed Management GIS staff Craig Fitzgerald and Paul Penner, using BWM and MassGIS data.

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Acronyms

The following are acronyms used in this report.

APA	American Planning Association, the primary professional planners' organization	DEM	The former Massachusetts Department of Environmental Management (currently Department of Conservation and Recreation, Division of State Parks and Recreation)
AST	Above-ground storage tanks	DEP	Massachusetts Department of Environmental Protection
ATV	All-terrain vehicles	DFA	The former Massachusetts Department of Food and Agriculture
AWWA	American Water Works Association, a professional water suppliers' organization	DOC	Dissolved Organic Carbon
BMP	Best Management Practices, including source and treatment controls on non-point source pollution	DOR	Massachusetts Department of Revenue
BOH	Board of Health, a board of local governments	DPW	Department of Public Works, part of town and city governments
BWM	Bureau of Watershed Management within the DCR Division of Water Supply Protection, the section responsible for the watershed system (formerly MDC/DWM)	DSPR	Division of State Parks and Recreation, a Division of DCR
CCR	Consumer Confidence Report	DUPR	Division of Urban Parks and Recreation, a Division of DCR
CDM	Camp Dresser & McKee Inc., an engineering consulting firm	DWM	Formerly the Division of Watershed Management, the Division of the MDC that was responsible for watersheds
CE	Civil Engineering, a section of the Bureau of Watershed Management	DWS	Division of Water Supply, a Division of DEP
CEI	Comprehensive Environmental Inc., an environmental consulting firm	DWSP	Division of Water Supply Protection, a Division of DCR
CFI	Continuous Forest Inventory	EAP	Emergency Action Plan
CFR	Code of Federal Regulations	EOEA	Executive Office of Environmental Affairs
CFU	Colony forming units	EPO	Environmental Police Office
Ch. 61	Chapter 61, part of the Massachusetts law that addresses taxes for forest and agricultural land	EP	Environmental Planning, a section of the Bureau of Watershed Management
CMP	Conservation Management Practices	EPA	Environmental Protection Agency
CMR	Code of Massachusetts Regulations	EQ	Environmental Quality, a section of the Bureau of Watershed Management
CR	Conservation Restriction	EQA	Environmental Quality Assessments
CVA	Chicopee Valley Aqueduct	ERP	Emergency Response Plan
DAR	Department of Agricultural Resources (formerly DFA)	FEMA	Federal Emergency Management Agency
DBP	Disinfection By-products	FERC	Federal Energy Regulatory Commission
DCR	Massachusetts Department of Conservation and Recreation	FTE	Full-time employee
		FY	Fiscal Year
		GIS	Geographic Information Systems

HAA	Haloacetic acid	O&M ORV	Operations and Maintenance Off-road Vehicle
I/I	Infiltration and Inflow		
ICR	Information Collection Rule	PILOT	Payments in Lieu of Taxes
ICS	Incident Command System	PPB	Parts per billion
IESWTR	Interim Enhanced Surface Water Treatment Rule		
		QWAC	Quabbin Watershed Advisory Committee
LT2	Long Term 2 Enhanced Surface Water Treatment Rule		
		RIZZO	Rizzo Associates, an engineering consulting firm
MADWEP	Massachusetts Drinking Water Education Partnership	ROW	Rights of Way
MASSGIS	A division of EOEA that manages state GIS data	RUSS	Remote Underwater Sampling Stations
MCL	Maximum Contaminant Level		
MDC	The former Metropolitan District Commission	SEA	Scientists/Engineers/Architects Consulting Inc., an engineering consulting firm
MDPH	Massachusetts Department of Public Health	SDWA	Safe Drinking Water Act
MEMA	Massachusetts Environmental Management Agency	SOP	Standard Operating Procedure
MEPA	Massachusetts Environmental Policy Act Unit	SWAP	Source Water Assessment Program
		SWTR	Surface Water Treatment Rule
MGD	million gallons per day	THM	Trihalomethane
MGL	Massachusetts General Laws		
MHD	Massachusetts Highway Department		
MOU(A)	Memorandum of Understanding (Agreement)	USDA	U.S. Department of Agriculture
MSP	Massachusetts State Police	USFWS	US Fish and Wildlife Service
MWRA	Massachusetts Water Resources Authority	USGS	United States Geological Survey
		UST	Underground Storage Tank
		VMP	Vegetation Management Plan
NALMS	North American Lakes Management Society		
NPDES	National Pollutant Discharge Elimination System	WAC	Watershed Advisory Committee
		WET	Water Education for Teachers
NR	Natural Resources, a section of the Bureau of Watershed Management	WPP	Watershed Protection Plan
		WREEN	Worcester Regional Environmental Educator's Network
NRCS	Natural Resources Conservation Service, a federal agency under the USDA	WSCAC	Water Supply Citizens Advisory Committee
		WsPA	Watershed Protection Act
		YOP	Yearly Operating Plan

1 Introduction

The Wachusett Watershed Protection Plan, as conceived and implemented, has been effective in maintaining the integrity of the watershed as a barrier against contamination of the Wachusett Reservoir.

U.S. District Judge Richard G. Stearns, May 5, 2000

The Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management (formerly the Metropolitan District Commission Division of Watershed Management) and the Massachusetts Water Resources Authority (MWRA), partners in delivering drinking water to over half of Massachusetts's citizens, are entering into a new era of facilities and management. The Bureau of Watershed Management has successfully reached watershed management milestones in water quality, monitoring, land acquisition, and sewer improvements. The MWRA is completing a ten-year, \$1.7 billion Integrated Water Supply Improvement Program. Together, these agencies enter the new millennium poised to continue providing safe drinking water for the next generation.

1.1 2003 Reorganization of State Agencies

A major reorganization occurred within the Executive Office of Environmental Affairs during the preparation of this plan. Chapter 26 of the Acts of 2003, § 290 created the new Department of Conservation and Recreation (DCR) by merging the Metropolitan District Commission (MDC) and the Department of Environmental Management (DEM). The DCR contains three Divisions: the Division of Urban Parks and Recreation (DUPR), the Division of State Parks and Recreation (DSPR), and the Division of Water Supply Protection (DWSP). The responsibilities of the former MDC Division of Watershed Management (MDC/DWM) have been transferred in their entirety to the Bureau of Watershed Management (BWM or "Bureau") within the Division of Water Supply Protection.

While the agency adjusts to changes to internal structures and nomenclature, the mission of the Bureau remains unaffected. The DCR/DWSP Bureau of Watershed Management, like the former MDC Division of Watershed Management, is legislatively mandated to manage and protect the drinking water supply watersheds, providing pure drinking water for distribution by the MWRA to approximately 2.2 million residents of Massachusetts.

Appropriate changes in terminology have been made throughout this document. In most cases the phrase "the Bureau" or the acronym BWM is used to reference both the current and former watershed management agency within the Department of Conservation and Recreation. In some contexts, particularly in historical discussions or referencing studies and publications, the terms "Metropolitan District Commission/Division of Watershed Management," MDC and MDC/DWM

remain accurate. In the context of this plan, “the Division” always refers to the Division of Water Supply Protection’s Bureau of Watershed Management or the former Division of Watershed Management, not to any other Division in the Commonwealth. The terms “Division lands” and “Bureau lands” refer to properties that are owned by the Commonwealth of Massachusetts and are under the care and control of the Division of Water Supply Protection, Bureau of Watershed Management.

1.2 Background

The *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* further advances, rather than replaces, MDC/DWM’s 1998 *Watershed Protection Plan Update for Wachusett Reservoir Watershed*. The MDC/DWM’s *Watershed Protection Plan Update for Quabbin Reservoir and Ware River Watersheds* prepared in 2000 remains in effect. Even though this plan is for the Wachusett Reservoir Watershed, specific information is given for all three BWM watersheds – Quabbin Reservoir, Ware River, and Wachusett Reservoir – based on their interdependence as a water supply system.

1.2.1 Metropolitan Boston Water System Sources

The Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management and the MWRA supply drinking water to 40 communities in the metropolitan Boston area. The Town of Clinton also draws water from Wachusett Reservoir, independent of the MWRA transmission and treatment system. Two communities near Wachusett Reservoir, Worcester and Leominster, may also withdraw water from the system for emergency supply. In addition, three communities west of Quabbin Reservoir obtain their water directly from this reservoir through the Chicopee Valley Aqueduct. MWRA is responsible for treatment and transmission, while BWM is responsible for collection and safe storage of water, protection of reservoir water quality, and management of the watersheds.

Figure 1-1 presents a system schematic. Quabbin Reservoir, the Ware River, and Wachusett Reservoir are the active water supply sources for the metropolitan Boston water system. Ware River water is transferred seasonally to Quabbin Reservoir, while Quabbin Reservoir water is transferred regularly to Wachusett Reservoir through the Quabbin Aqueduct. Wachusett Reservoir is the terminal supply reservoir. Water is withdrawn through the Cosgrove intake at the eastern end of Wachusett Reservoir, and is carried by the Cosgrove Tunnel to the distribution system. The Wachusett Aqueduct provides redundancy to the Cosgrove Tunnel; it was used during the winter of 2003-2004 to allow connections to be made to MWRA’s new Walnut Hill Treatment Plant.

The Sudbury and Foss (Framingham #3) Reservoirs are the emergency reserve water supplies for this system. There are three emergency conditions that would require the use of the Sudbury System: 1.) Wachusett Reservoir is declared non-potable; 2.) there is an inability to convey water from the Wachusett Reservoir to the MWRA system (e.g., failure of the Hultman Aqueduct, Southborough Tunnel, or the City Tunnel); or 3.) a serious drought occurs.



**Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management**

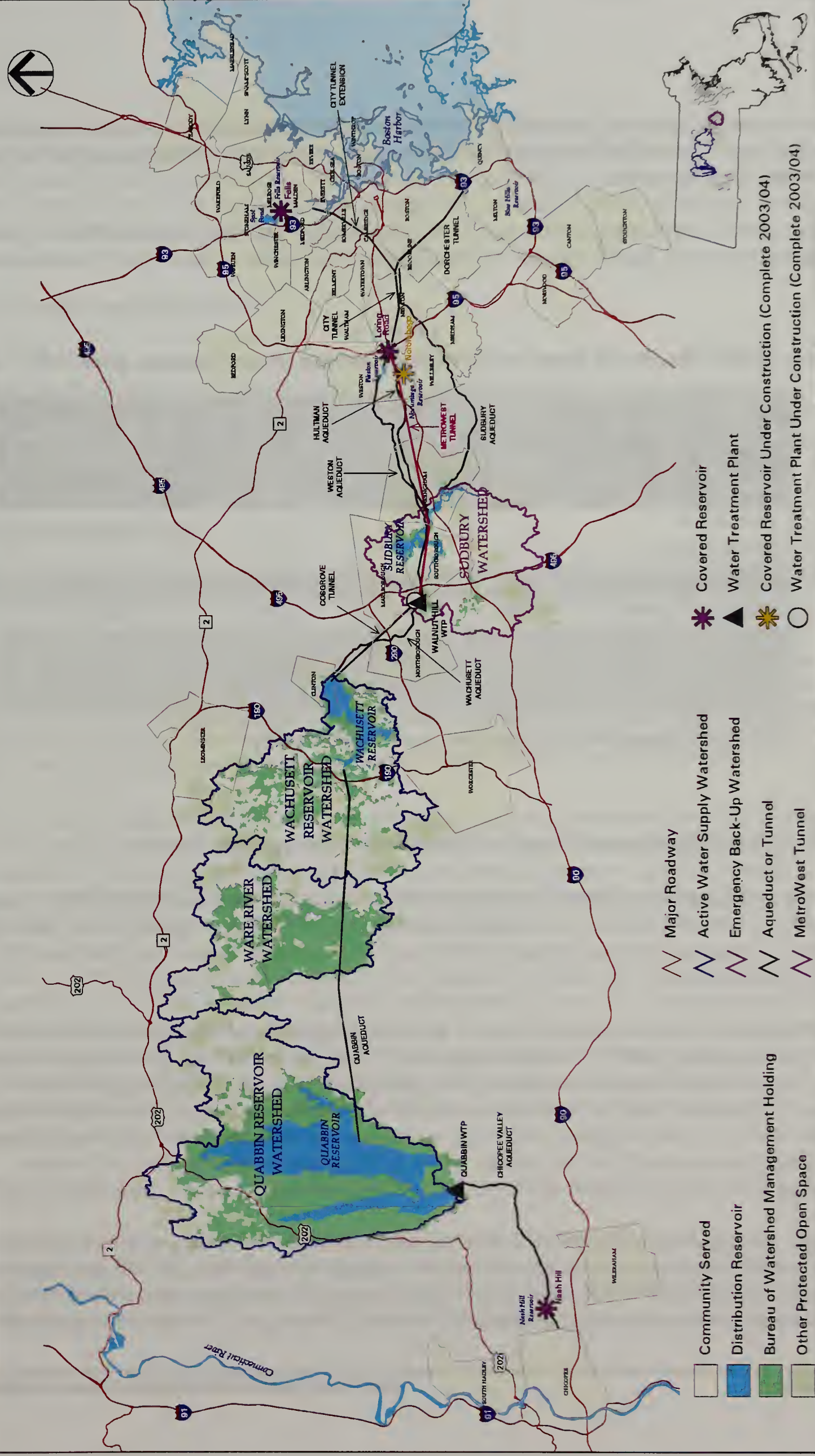


Figure: 1-1

Depending on the situation, the Sudbury Reservoir would be used either as a primary source of water supply, as a pass through of Wachusett Reservoir water, or as a supplemental source to the Quabbin and Wachusett Reservoirs.

The past decade's withdrawals from each source water supply are summarized in **Table 1-1**; see **Section 2.3** for water quality data and **Section 5.1** for information on water quality monitoring.

Table 1-1:
BWM Watershed Areas and Withdrawals from System Sources, 1990 - 2000

Source	Watershed Area ¹		Net Average Annual Withdrawal (mgd)	Average Annual Withdrawal ² (mgd)
	square miles	acres		
Ware River (MWRA Intake)	96	61,740	110	8.08 ²
Quabbin Reservoir	187	119,940	195.2	137.9
Wachusett Reservoir	117	74,890	127.4	123.1
Total DCR/MWRA Water Supply System	401	256,570	432.6	261

Source: Watershed Statistics – DCR/DWSP/BWM GIS; Water Withdrawal Statistics: MWRA, 2003

¹ Including area of reservoir surface for Quabbin Reservoir and Wachusett Reservoir.

² This is not a supply but a transfer to Quabbin Reservoir

1.2.1 Safe Yield Estimation Model – DCR/MWRA Water Supply System

Over the years, models and plans have been developed and refined to evaluate the MWRA system capacity. A Safe Yield Model was developed in the early 1980s that simulated inflow and outflow of water into the reservoirs using data for fifty years. It concluded that the safe yield was 300 million gallons a day.

Safe Yield alone, however, does not capture all the features of the system that are of concern to watershed protection, MWRA, and the ratepayers. Consequently, MWRA collaborated with the U.S. Army Corps of Engineers and other study participants (e.g., the Water Supply Citizens Advisory Committee (WSCAC)) in the *National Study of Water Management During Drought* in order to develop a new computer model that incorporated an expanded set of performance measures. The newer reservoir model is the one used by the MWRA to simulate the effects of various operating scenarios and demand levels on reservoir performance measures.

Drought Action, as defined in MWRA's Drought Management Plan, emerges as one of the most important performance measures to consider. It is triggered before other performance measures and is the most tangible to MWRA customers. Various stages of system operation are tied to trigger ranges based on the current level of Quabbin Reservoir. The stages of drought emergency are used

to target water use reductions. At normal operation and 80% full, there are no target water use reductions. Stage 1, 2, or 3 Drought Emergency would initiate, respectively, 10%, 15%, or 30% mandatory target water use restrictions. The modeling shows that during a severe drought, like the one that occurred in the 1960s, there would be an increasing number of months of Stage 1 Drought Emergency as demand increases from 240 mgd upwards.

1.2.2 Contributing Watersheds

The three contributing watersheds to Wachusett Reservoir water – Quabbin Reservoir, Ware River, and Wachusett Reservoir – total 256,570 acres, or approximately 400 mi². Each watershed is predominantly forest, with some developed rural land uses. BWM owns about 42% of the total watershed area, and other agencies, municipalities and private agencies protect another 21% of the watershed area.

Quabbin Reservoir Watershed

The Quabbin Reservoir watershed consists of 119,940 acres, including the reservoir surface that is approximately 25,000 acres (when full) at elevation 530'. A significant portion of the Quabbin Reservoir's annual inflow is from direct precipitation that contributes about 30% annual inflow. Direct inflow from the watershed's tributaries provide 61% of the annual inflow; 17% of the total annual inflow comes from largest tributary, the East Branch of the Swift River. Other Quabbin Reservoir watershed tributaries include: the West and Middle branches of the Swift River, and Hop, Fever, and Dickey Brooks. Quabbin Reservoir also receives about 9% of its annual yield from transfers of water from the Ware River at the MWRA intake.

Ware River water transfers enter Quabbin Reservoir above the area of the intake and, due to a baffle dam, these transfers travel several miles and mix with Reservoir water before reaching the Quabbin Aqueduct intake. This process provides significant travel time (on the order of several years) allowing sunlight and biological processes to naturally treat the water, settling suspended solids and reducing color in Ware River inflows prior to reaching the intakes.

About 93.3% of the aggregated land use/land cover in the Quabbin Reservoir watershed and Ware River watershed land cover is undeveloped forests, wetlands and open water. The remaining 6.7% of the aggregated land cover/land is developed including uses such as agriculture (3.6%), residential (2.1%), other developed (0.8%), and relatively few commercial uses (0.2%), most in the distant, upper portions of the watershed. Twelve municipalities are wholly or partially located in the watershed: Athol, Barre, Belchertown, Hardwick, New Salem, Orange, Pelham, Petersham, Phillipston, Shutesbury, Ware, and Wendell.

Ware River Watershed

The Ware River watershed totals 61,740 acres. Ware River transfers are authorized between October 15 through June 15, and only river flows exceeding 85 mgd can be transferred. The transfers to Quabbin Reservoir are also limited to times when the Quabbin Aqueduct is not being used to transfer Quabbin water to Wachusett Reservoir. Ware River water is transferred to Quabbin

Reservoir based on operating rules that consider reservoir levels, seasonal hydrologic conditions and water quality. Since 1992, DCR/MWRA operating policy has been to divert Ware River to Quabbin Reservoir only, although Ware River water can be transferred to Wachusett Reservoir using the Quabbin Aqueduct.

Wachusett Reservoir Watershed

The Wachusett Reservoir watershed is about 74,890 acres in area, including the 4,122 acre reservoir, and features an extensive network of streams and rivers feeding the reservoir. Quabbin transfers are the largest source of inflow to Wachusett on an annual basis (about 50%). The largest tributaries, Stillwater and Quinapoxet Rivers, together contribute another 30% of annual inflow and drain 75% of the watershed area. Both rivers, as well as Quabbin transfers, flow into Thomas Basin at the western end of the reservoir. Due to the constricted outflow from the basin into the main body of the reservoir, Thomas Basin acts as a sedimentation basin for almost 90% of Wachusett Reservoir inflows. This important feature contributes significantly to the reservoir's excellent water quality.

About 75% of the watershed is currently undeveloped forests and wetlands, including 52% BWM-owned or conservation land. The remaining 25% of the watershed includes 8% agriculture use, 9% residential use, less than 1% commercial office or industrial uses and 7% in other uses, including: transportation facilities (several highways and a railroad), and recreation. Most of the watershed lies in five municipalities: Boylston, West Boylston, Holden, Sterling, and Princeton. Parts of the watershed also extend into seven other municipalities: Clinton, Worcester, Paxton, Rutland, Hubbardston, Westminster, and Leominster.

1.3 Purpose

1.3.1 Previous Plans

MDC and MWRA developed two watershed protection plans (referred to as WPPs or Plans) in 1991: one plan for activities in the Wachusett Reservoir watershed and another plan for activities in the Quabbin Reservoir and Ware River watersheds. These were the first formal written plans to address the comprehensive protection of the water supply watershed system.

The Quabbin Reservoir/Ware River Plan was submitted to Massachusetts Department of Environmental Protection (DEP) in conjunction with a request for a waiver from filtration for the Chicopee Valley Aqueduct system in 1991. MDC's implementation of the Plan began in 1991. DEP approved the Plan in January 1992.

The Wachusett Reservoir Watershed Protection Plan was not immediately submitted to DEP for approval since a filtration waiver was not initially requested for that source in 1991. MDC, however, did begin implementation of the Wachusett Plan in January 1992. Following the dramatic success of initial protection efforts, MWRA, MDC, and DEP, in June 1993, entered into a consent order establishing a "dual track" approach to determine treatment requirements of the metropolitan Boston system. Thus, it was not until September 1993 that the Wachusett Plan was submitted to DEP for formal approval, along with the addendum "Updated Information to Accompany the

Submittal of the Watershed Protection Plan, Wachusett Reservoir Watershed.” The addendum included a schedule proposing activities to implement the Plan through 1998.

In a letter dated May 24, 1994, DEP found the Wachusett Reservoir Plan to be in accordance with DEP Policy 89-09 and DEP’s guidance document, and commented that the Plan was comprehensive. DEP also approved the Implementation Schedule with one modification concerning the state’s Title 5 regulations, which were being revised at the time. DEP’s letter also includes an attachment, essentially calling for prevention of waterborne disease as the top priority.

MDC/DWM submitted the first full update of the Wachusett Reservoir Watershed Protection Plan in December, 1998; the Quabbin Reservoir/Ware River Watershed Protection Plan Update was published in December, 2000. Thus, both the Wachusett Reservoir Watershed and Quabbin Reservoir Watershed/Ware River Watershed Protection Plans and their respective updates have been approved by DEP, forming the basis for BWM’s programs since 1991.

1.3.2 Need for Plan Update

Since the original Plans were prepared in 1991, BWM has greatly expanded its watershed protection programs. The 1998 *Watershed Protection Plan Update for the Metropolitan Boston Water System Wachusett Reservoir* (the 1998 Plan) established a new set of objectives for BWM to attain. Some of the Bureau’s significant achievements over the past five years include:

- Utilizing a leading-edge land acquisition model and purchasing thousands of acres of watershed lands.
- Maintaining a successful wildlife control program.
- Updating Public Access and Land Management Plans.
- Sustaining the watershed ranger program.
- Implementing the Watershed Protection Act land use regulations.
- Replacing watershed sanitary surveys with more detailed sub-basin Environmental Quality Assessments.
- Creating wastewater pilot projects.
- Supervising the installation of sewers in the most critically impacted sections of the watershed.
- Developing a community Technical Assistance contract program.
- Sponsoring public education projects.
- Achieving no fecal coliform bacteria counts above the 20 cfu/100 ml limit since January, 1999.

These measures have augmented BWM’s understanding of potential watershed contamination sources, their influence on intake water quality, and the most feasible and effective control approaches.

Another reason for the Plan update is the DCR and MWRA focus on public health and the continued high priority concern of the U.S. Environmental Protection Agency (EPA) and DEP focusing on the threat of *Giardia* and *Cryptosporidium* pathogens. The studies conducted by DWM over the past

five years concerning watershed processes and potential pollution sources, along with the federal and state agencies' ongoing focus on pathogens, have advanced the BWM watershed protection program beyond the frameworks provided by the 1991 and 1998 Plans.

Throughout the early 1990s, MWRA also conducted a series of studies and plans to determine its approach to system treatment. MWRA evaluated both filtration and non-filtration alternatives to comply with the Safe Drinking Water Act (SDWA) regulations. MWRA chose a balanced investment strategy of watershed protection, improved treatment with ozone, a new distribution tunnel and covered storage facilities, and an extensive program to rehabilitate community water pipes. In October 1998, MWRA and MDC/DWM submitted an application for a waiver from the filtration requirement for the Wachusett Reservoir (**see Section 1.4**). As a component of the application for this waiver, MDC/DWM and MWRA were committed to update this Plan on a five-year cycle.

Throughout this past five-year period, the BWM has been refining its strategies to best meet the goals of the Watershed Protection Plan. Several significant management plans have been developed or revised, representing the framework for the agency's approach to water quality protection. This Plan Update unifies the goals and objectives described in the following plans:

- 1998 Land Acquisition Plan (Section 4.1).
- 2001 Wachusett Land Management Plan (Section 4.2.3).
- 2003 Public Access Plan (Section 4.2.1)

The Bureau has also commissioned several studies by expert consultants on a variety of technical topics, including:

- 1999 Stormwater Management, by Camp, Dresser and McKee, Inc. (Section 6.2)
- 1998 Agriculture, by Comprehensive Environmental, Inc. (Section 6.4.2)
- 1998 Highways/Railways Hazardous Material Transportation Release Control Project by Rizzo Associates (Section 6.2 and 6.3.2)
- 1997 Hazardous Materials Emergency Response Plans, by Comprehensive Environmental, Inc. (Section 6.3.2)

The Watershed Protection Plan acts as an “umbrella” for all of the Bureau's activities. This document presents the most critical elements of each management plan and study; the individual plans and studies provide substantially more detail on their particular issues.

Both MWRA and DCR are dedicated to watershed protection as part of a multi-barrier approach to drinking water quality. This Plan Update provides an opportunity to consider the implementation of DWM's programs since 1998, integrate the increased knowledge of water quality and watershed sources of concern, and set a focused watershed protection agenda for the next five years.

1.4 Regulations and Policies Concerning Watershed Protection Plans

This Plan Update is intended to provide BWM with a focused program of activities for the next five years, reflecting the agency's goals and priorities, and to satisfy DEP and EPA criteria for watershed protection for unfiltered systems. The Plan's content has been organized to address the various regulations and guidelines pertaining to adequate watershed protection (see **Table 1-2**)

The following subsections describe these regulations and policies, their guidelines for watershed protection plans, and how these requirements are reflected in this 2003 Plan Update.

1.4.1 Surface Water Treatment Rule (SWTR)

The federal SWTR regulations were promulgated in June 1989 to reduce the risk of waterborne disease from microbial pathogens.

The SWTR provides two paths for adequate public health protection. It requires filtration for all surface drinking water supplies, unless the water supply is of very high quality and meets specific criteria to qualify for a waiver. One of these criteria is an adequate watershed control program. The rule emphasizes the need for the watershed control program "to minimize the potential contamination by *Giardia* cysts and viruses in the source water," and requires an equivalent level of treatment through disinfection.

The SWTR establishes minimum requirements of the watershed control program as:

- Assessing the hydrology, land cover, and land use characteristics of the watersheds.
- Describing activities or characteristics of the watershed that may impact source water quality adversely.
- Monitoring and controlling these activities or characteristics.

In addition, the SWTR also requires that the public agency responsible for watershed management demonstrates control over the watershed's land, either through land ownership or through agreements with private land owners. There must also be an annual survey by the primacy agency (in this case, DEP) that documents the effectiveness of the watershed control program.

This 2003 Plan Update includes all required elements: Section 2 addresses hydrology and land use. Section 4 describes control of watershed lands, Section 5 addresses monitoring, and Section 6 identifies potentially adverse activities and their controls.

Table 1-2
Regulations and Policies Concerning Watershed Protection Plans

Regulatory Agency	Name	Year
EPA, DEP	Surface Water Treatment Rule	1989
EPA	Guidance Manual for Compliance with the Filtration and Disinfection Requirement	1990
DEP	Policy 89-09 – Watershed Resource Protection Plan Policy	1990
DEP	Guidance on the Preparation of a Watershed Resource Protection Plan	1990
DEP	Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Supplies to Obtain, and Maintain, a Waiver from Filtration Requirements (“Measures of Success”)	1996
DEP	“Developing a Local Surface Water Supply Protection Plan”	1996
DEP, EPA	State Source Water Assessment & Protection Program Guidance	1997
EPA, DEP	Interim Enhanced Surface Water Treatment Rule	1998
EPA	Long Term 2 Enhanced Surface Water Treatment Rule (LT2)	2003

Source: DCR/DWSP/BWM and MWRA, 2003.

1.4.2 EPA Guidance Manual for Compliance with the Filtration and Disinfection Requirement

The SWTR contains few specific requirements for watershed control, beyond the general topics listed above. EPA’s interpretation and application of the SWTR watershed control requirement is described in the *Guidance Manual for Compliance with the Filtration and Disinfection Requirement for Public Water Systems Using Surface Water Sources* (EPA, October 1990).

This manual presents advisory guidelines to primacy agencies. It defines a watershed control program as “a surveillance and monitoring program which is conducted to protect the quality” of a source. Specific elements of a watershed control program are recommended, each of which is addressed in this 2003 Plan Update as shown in **Table 1-3**.

1.4.3 DEP Policy 89-09 and Guidance on the Preparation of a Watershed Resource Protection Plan

In January 1990, DEP issued Policy 89-09, *Watershed Resource Protection Plan Policy*, which concerns the minimum information to be included in a watershed plan submitted under the SWTR

filtration avoidance procedures. The Policy requires the same six elements identified in the EPA Guidance Manual. In addition, the Policy identifies a series of map overlays to be prepared, and some additional detail concerning the contents of the six elements.

This plan includes all of the required content. All maps were created in ARC/INFO or ArcView format and are compatible with MassGIS and DEP standards. **Table 1-3** summarizes DEP Policy 89-09 along with notations of where each requirement is contained in this Plan Update.

1.4.4 DEP Measures of Success

DEP has prepared a document titled “Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Suppliers to Obtain, and Maintain, a Waiver from Filtration Requirements, Draft #5” dated April 11, 1996. Referred to as the “Measures of Success,” the document specifies DEP’s process for assessing requests for filtration waivers and criteria – termed programmatic milestones – to measure the success of the water supplier’s watershed efforts.

The “Measures of Success” identifies programmatic milestones organized into the following topics:

- | | |
|--------------------------------|---------------------------------------|
| 1. Watershed Control | 6. Sampling |
| 2. Public Access/Recreation | 7. System Operation/Maintenance |
| 3. Wildlife Management | 8. Staffing |
| 4. Infrastructure Improvements | 9. Emergency Planning/Response |
| 5. In-lake Problems | 10. Education/Multi-town Coordination |

To aid in comparing the Plan Update to the “Measures of Success,” the matrix in Appendix A shows each programmatic milestone, the status of that milestone in the Wachusett Reservoir watershed, and references to relevant sections of this Plan.

1.4.5 DEP’s “Developing a Local Surface Water Supply Protection Plan”

This document, prepared in July 1996, is intended to provide water suppliers with a low-cost method to develop a plan. The guidance is based on two maps and seven sections. Although this guidance was intended for smaller, less sophisticated water supplies and does not apply to the more advanced BWM program, this Plan Update does contain the identified items.

1.4.6 DEP’s Source Water Assessment Program (SWAP)

The Federal Safe Drinking Water Act Amendments of 1996 emphasize the importance of protecting public drinking water. The law requires every state to examine existing and potential threats to the quality of all its public water supply sources and to develop a Source Water Assessment Program (SWAP). DEP’s SWAP process has delineated protection areas for all public ground and surface water sources, inventoried land uses in these areas that may present potential threats to water quality.

Table 1-3

Location of EPA Guidance Manual and DEP Policy 89-09 Requirements in Plan Update

Item	Plan Update Section
Report Submission	
▪ Narrative	1
▪ Maps	Throughout Plan
A. Watershed Description	2
▪ Location of major physical features and system components	
○ Watershed zones A, B, C	
▪ Hydrological characteristics	
B. Identification of Watershed Characteristics and Activities Detrimental to Water Quality	2, 3
▪ Naturally occurring sources	6.4
○ Erosion potential	6.4.1
○ Animal populations	4.2.2, 6.4.2
▪ Manmade contamination sources	5, 6
○ Activities subject to state/federal approval	5.2.2
○ Sewered areas	6.1.2
○ Gas stations and petroleum storage	5.2
○ Zoning	3, 5.2.1
○ Land use	3, 5.2.1
○ Hazardous waste sites	3
C. Risk Assessment and Control of Detrimental Activities/Events	
▪ Summarize results and assess risk	2
▪ Control mechanisms	
D. Monitoring	5
○ Source water information, Monitoring sites	
E. Agreements and Delineation of Land Use/Ownership	
▪ Land ownership	4.2.3
▪ Efforts to obtain ownership	4.1
▪ Efforts to obtain agreements and control	4.1
▪ Compliance with agreements	4.1
F. Management/Operations	
▪ Management	9
○ Organization structure	
○ Staff requirements	
○ Staff education, certification, and training	
○ Annual report	
▪ Operations	
○ Ongoing patrol to identify and react to potential impacts	4.2., 5, 6
○ Emergency response plan; Operational changes	6.3.2, 7

Source: DEP. 1990; DCR/DWSP/BWM, 2003

determined the susceptibility of water supplies to contamination from these sources, and publicized the results. Source Water Assessments are intended to help local and state officials target inspections and technical assistance where they are needed the most, encourage cooperative emergency response, and contribute to comprehensive protection of all public water sources.

Information in the SWAP is also required in the MWRA's annual Consumer Confidence Report (CCR). The first SWAP for the Wachusett Reservoir watershed was completed in 2002. DEP noted that the BWM "meet DEP's annual review of 'Measures of Success' for implementation of Watershed Protection Plans and disinfection treatment processes." The SWAP further notes that "MDC [has] implemented DEP-approved Watershed Protection Plans to protect source waters since 1991" (DEP, 2002). Because the SWAP was developed by a uniform, statewide process based on information available for every source, the reports contain much more general information compared to the site specific data in this Watershed Protection Plan or other watershed management documents by either the BWM or MWRA.

1.4.7 EPA Interim Enhanced Surface Water Treatment Rule (IESWTR)

EPA promulgated the Interim Enhanced Surface Water Treatment Rule (IESWTR) in December, 1998. The IESWTR builds on the SWTR, adding requirements of treatment and control for *Cryptosporidium*. The IESWTR adds the specific requirement that unfiltered water systems must maintain a watershed control program to minimize the potential for *Cryptosporidium* contamination, including identifying and monitoring watershed characteristics and activities that may have an adverse effect on water quality.

The IESWTR includes the following provisions: 1.) A Maximum Contaminant Level (MCL) goal of zero is established for the protozoan genus *Cryptosporidium*; and 2.) Surface water systems that are required to filter under the SWTR must achieve at least 2 log removal of *Cryptosporidium*. In the IESWTR, EPA states, "it appears that unfiltered water systems that comply with the source water requirements of the SWTR have a risk of cryptosporidiosis equivalent to that of a water system with a well-operated filter plant using a water source of average quality."

EPA planned to continue evaluating this issue when additional data becomes available. This Plan Update has been prepared to minimize potential for water contamination from *Cryptosporidium*, as well as *Giardia* and pathogenic bacteria and viruses.

1.4.8 New Federal Drinking Water Regulations

The 1996 Amendments to the Safe Drinking Water Act called for EPA to issue two new regulations by May 2002: the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 Disinfectants/Disinfection By-products Rule (Stage 2 D/DBP). EPA has been developing these rules, for both filtered and unfiltered water supplies, in order to increase protection against microbial pathogens while limiting the by-products of disinfection treatment. The draft rules were published in the summer of 2003; the final rules are expected to be promulgated in spring 2004. The most important impact of these new regulations is the likely requirement by 2012 for 99%

inactivation of *Cryptosporidium* and use of a second primary disinfectant. Disinfection is the responsibility of MWRA as it delivers the source waters from Wachusett and Quabbin Reservoirs to its customers in 47 communities.

Long Term 2 Enhanced Surface Water Treatment Rule

The purpose of the LT2ESWTR (or LT2) is to improve protection of consumers against the protozoan pathogen *Cryptosporidium* originating in the source water. This is directly related to successful watershed protection measures in primarily controlling animal (e.g., beaver and other wildlife) sources. The principal components of LT2 of importance to the DCR and MWRA include:

- Tiered levels of treatment for both filtered and unfiltered water supplies based on the testing of *Cryptosporidium* levels in source waters (eliminating the prior “one size fits all” approach).
- Requiring a minimum 2-log (99%) inactivation of *Cryptosporidium* for unfiltered supplies, with 3-log (99.9%) required if source water testing shows an average of more than 1 *Cryptosporidium* oocyst per 100 liters. Current reservoir samples indicates that the DCR/MWRA system is likely to stay well below the 1/100 liter trigger.
- Unfiltered supplies must use at least two primary disinfectants, with one achieving the 4-log virus inactivation. Primary disinfection is designed to inactivate (kill) pathogens. Residual disinfection is designed to maintain the safety of the water as it passes through the distribution system on its way to consumers. MWRA currently uses chlorine for primary disinfection, and chloramines for residual disinfection. The new Walnut Hill Water Treatment Plant is designed to use ozone as primary disinfectant and chloramines as residual disinfectant when it goes on-line in January 2005.
- Unfiltered supplies must add *Cryptosporidium* control to their watershed protection plans and all current filtration avoidance criteria must continue to be met. The DCR/MWRA system is currently in full compliance with this avoidance criteria.

EPA lengthened the compliance time line to approximately eight years by including the need to conduct two years of source water sampling for *Cryptosporidium* prior to making decisions about the regulations’ level of treatment. Compliance with these regulations, therefore, will not be required until about 2012.

An unexpected factor that arose during the course of the regulatory negotiation process was that ultra-violet (UV) light was found to be a powerful disinfectant against *Cryptosporidium* and *Giardia*. This surprising finding altered the negotiation process as it made inactivation of *Cryptosporidium* much less expensive than previously thought for both filtered and unfiltered systems. MWRA concluded that UV had potential for use at both Wachusett and Quabbin Reservoirs. It was too late in the construction process for immediate inclusion in the Walnut Hill Water Treatment Plant, however it is seen as the most likely disinfection process for the facilities necessary to inactivate *Cryptosporidium* at both Quabbin and Wachusett Reservoirs.

Stage 2 Disinfectants/Disinfection By-products Rule

Disinfectants such as chlorine interact with naturally present organic matter in the source water to form various by-products. The amount of organic matter in the source water is directly related to the ability of watershed protection measures to control contaminant introduction in a reservoir and its tributaries.

Previous disinfection by-products (DBPs) rules focused on certain chlorine by-products, which at high enough doses over many years may cause cancer. These regulations controlled levels as averaged over all sample locations over four quarters. MWRA's DBP levels have always been below the levels considered potentially problematic. Some toxicological and epidemiological studies over the last few years have raised the possibility that these by-products might also cause developmental and reproductive impacts (miscarriages and birth defects), but over a much shorter period (weeks to months). One goal, therefore, of the Stage 2 Disinfectants/Disinfection By-products Rule (Stage 2 D/DBP or Stage 2 Rule) was to reduce the variability (or high points) of the DBP levels within drinking water systems. The principal components of the Stage 2 Rule of importance to the DCR/MWRA water supply system include:

- The average trihalomethane (THM) MCL of 80 parts per billion (ppb) and average haloacetic acid (HAA) MCL of 60 ppb will remain unchanged.
- An important change will be made in the method of measurement for these contaminants. Sampling will have to include those locations most likely to have high levels and each location will be averaged separately. This Locational Running Annual Average has the effect of reducing allowable levels by about a half for systems that use free chlorine for their residual disinfectant. MWRA expects to be able to comply with these requirements based on the use of the slower reacting chloramines for residual disinfection. THM's and HAA's will also be substantially reduced from their current levels when the Walnut Hill Water Treatment Plant goes on-line in January 2005.
- Drinking water systems will need to re-examine their THM and HAA sampling locations and many will need to conduct a short-term, extensive sampling program to identify locations where DBPs are higher to determine where the compliance samples should be taken. There will also be a variety of complex transitional issues laid out in the rule, primarily to allow EPA to keep the compliance schedules of the two rules in-sync, but also to move systems from the current rule to the new, without having any increase in risk.
- The average bromate (a by-product of ozonation) MCL of 10 ppb will remain unchanged. Initial tests conducted for bromate indicate that the new treatment plant will be in compliance with the 10-ppb standard when it goes on-line in January 2005.

The process and timetable for Stage 2 Rule promulgation are the same as the LT2. Compliance is also expected by the year 2012. Watershed protection and the designed operation of the DCR/MWRA reservoir system can control the amount of organic material in the source water and reduce the potential for DBP formation.

1.5 Filtration Waiver

The MWRA Board of Directors voted in October, 1998, to build a new water treatment facility using ozonation with chloramination for disinfection and other treatment objectives for the water from Wachusett Reservoir. MWRA's treatment technology decision was the culmination of a ten year process of study and research on the needs of the water supply system, current information on water treatment effectiveness on pathogens of concern, disinfection byproducts, watershed protection and public health concerns, with input from the public and water supply and public health experts. The Authority's conclusion was that an ozonation/chloramination plant would provide appropriate treatment of the water supply from Wachusett Reservoir, and that adding filtration to the new plant for \$180 million would not provide as much additional benefit as would using funds to rehabilitate old unlined cast iron pipes in the MWRA and local distribution systems. As part of the treatment technology decision, MWRA expanded a program of public health surveillance and financial incentives for communities to target rehabilitation of community pipes, and proposed a full review of the need for further treatment including filtration by December 2003.

This plan was presented to the Massachusetts Department of Environmental Protection (DEP) under the provisions of the June 1993 administrative consent order between DEP, MWRA and MDC. That consent order allowed MWRA and MDC to pursue a "dual track" for regulatory compliance with the Surface Water Treatment Rule (SWTR) of the Safe Drinking Water Act (SDWA) for the Wachusett Reservoir. It required MWRA to design a filtration plant and to build it, unless MWRA could demonstrate with MDC that the system met the criteria for avoiding filtration and DEP determined that filtration was not required.

DEP agreed with MWRA's approach in December 1998 after a hearing and comment period, and determined that filtration was not required for the DCR/MWRA system. EPA, however, did not agree and continued to prosecute the enforcement action previously filed under its SDWA "overfiling" rights, seeking to require MWRA to build a filtration plant, contending that the SDWA allowed no other option.

In December 1998, the EPA moved for partial summary judgment claiming as a matter of law that MWRA was in violation of the SWTR and that the Court was required to order filtration.

In May 1999, U.S. District Judge Richard Stearns granted the United States' motion in part, ruling that MWRA was not in compliance with the filtration waiver criteria as a result of its having detected fecal coliform bacteria levels in the reservoir above permissible levels on 14 days (in December 1998 and January 1999) out of 130 days tested for the six month period. The SDWA criteria permit exceedances on only 13 days in a six month period (10% of the samples). However, the Court ruled that it had discretion to order a remedy other than filtration and set the question of remedy for trial beginning in October. Judge Stearns reasoned that judicial discretion was necessary since technology evolves more rapidly than legislation and "an overly rigid application of the filtration mandate by the EPA might result in a wasteful expenditure of finite public funds to correct de minimis problems." (Kurtz, 2000)

The trial date was postponed when the United States sought to appeal the ruling, claiming that whether or not the Court has discretion to order a remedy other than filtration was a controlling

question of law that should be decided prior to any trial. The U.S. Court of Appeals for the First Circuit denied the Government's request for appeal, and the trial began in December. After two months of testimony, the U.S. District Court ultimately concluded that the comprehensive strategy to improve drinking water proposed by MWRA and MDC/DWM, through watershed protection for Wachusett and Quabbin reservoirs, a new ozonation/chloramination disinfection facility, and a community pipe rehabilitation program, sufficiently protects the public health and cost-effectively improves drinking water quality. (Kurtz, 2000; *U. S. v. MWRA*, 97 F.Supp.2d 155)

An appeal was made by the EPA to the US Court of Appeals, arguing that the District Court did not have the discretion to rule on any injunction other than building a filtration plant if there was a violation of the SWTR. The Appeals Court again ruled in favor of the MWRA.

The Appeals Court noted that it was not faced with an imminent threat to public health as none had been alleged by the United States. After discussing the language and intent of the SDWA, and comparing it to other regulatory enforcement schemes, the Court found that the statute did not create a "necessary and inescapable inference" as to the necessity of filtration upon a finding of a regulatory violation. The Court also found that the goal of the SDWA was safe drinking water, and that although filtration served an important role, it is merely a prophylactic remedy: "the manifest purpose of the SDWA is safe drinking water, not filtration."

In affirming the district court's exercise of discretion, the Court noted that "the district court did not hold a trial to revisit the underlying wisdom of the SWTR; rather, it held a trial to ascertain whether, based on both the particular facts of this case and the substantive goals of the Act, it was more appropriate to order filtration or to permit the MWRA to pursue its alternative approach to the extent that it could satisfy the Rule's avoidance criteria and ultimately provide a safer water supply." The Court noted that "it should be a rare case in which violation of regulatory standards does not lead to an injunction" but it agreed with the district court that this was indeed such a rare case. It found that the district court had carefully shaped its decision to ensure continued compliance with the avoidance-criteria standards, and retained jurisdiction "for the purpose of policing any future violation." Thus, "the district court used its equitable discretion to appropriate ends: furthering the substantive purposes of the Act." (Kurtz, 2001; *U. S. v. MWRA*, 97 F.Supp.2d 155)

The EPA did not appeal this decision to the U.S. Supreme Court. Therefore, the District Court "assumed the responsibility of monitoring MWRA's compliance in the event that future violations require re-examination of the decision not to order filtration." (*U. S. v. MWRA*, 256 F.3d 36)

1.6 Scope of 2003 Plan Update

The DCR has been aggressively implementing and expanding its watershed programs since the initial Watershed Protection Plan was published in 1991. The U.S. District Court recognized this progress, when it stated:

The story of Wachusett water quality in the last decade has been one of continuing improvement, in some respects gradual, in others dramatic...The milestones in this progress [are]... (a) the passage by the Legislature of the 1992 Watershed Protection Act; (b) the strong public support generated by conservation groups for the MDC's largely successful efforts (to date) to preserve and protect the Wachusett watershed; (c) the full implementation of the gull harassment program;... and (h) the sewerage of septic systems in the Towns of West Boylston and Holden. (*U. S. v. MWRA*, 97 F.Supp.2d 155)

The 2003 Wachusett Reservoir Watershed Protection Plan Update continues this trend of identifying key issues and setting priorities for the DCR Bureau of Watershed Management. This Plan Update:

- Documents the recommendations of the 1998 Plan that have been completed.
- Incorporates increased knowledge of the watershed and water quality.
- Assesses the current "state of the watershed."
- Formally states goals and five-year objectives for each program area.
- Establishes a schedule of activities for the next five years.

The BWM's 2000 *Watershed Protection Plan Update for the Quabbin Reservoir Watershed and Ware River Watershed* is unchanged by this document.



2 Watershed Assessment

Planning for management and control of a watershed must begin with an understanding of the natural processes and human development characteristics that influence water flows and quality. A comprehensive assessment of watershed conditions was presented in the previous Watershed Protection Plan Update (MDC, et al., 1998) which remains as an adequate reference. Recent Environmental Quality Assessment Reports (MDC, 2002; MDC, 2003; MDC, in press) also contain useful information on natural characteristics, land use and development, hydrology, and water quality addressed at the subbasin level. A summary of this information along with any recent changes or updates are included in Section 2.

2.1 *Natural Characteristics*

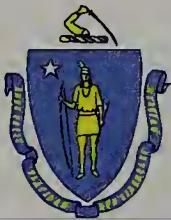
Key Points

- The topography of the watershed is mainly hilly, encompassing flatter wetlands and flood plains, as well as some mountainous terrain with exposed bedrock.
- Watershed geology features glacial till deposits on uplands and glacial outwash deposits on lowlands and valleys.
- Soils have low to moderate erosion potential, and because the watershed is heavily forested and generally lacks steep slopes, the extent of erosion prone areas is limited.
- Soils are generally not well suited for the disposal of wastewater through septic tanks, but strict Title 5 regulations set in place in 1995 are expected to prevent newer septic tanks from posing a threat to groundwater quality and to gradually replace or upgrade older substandard tanks.
- Most of the watershed land is forested, and a large portion of the forested area is owned by the BWM or otherwise protected.
- BWM has subdivided the Wachusett Reservoir watershed into 49 smaller subbasins and uses these to organize and track watershed protection programs, identify problems, and implement solutions.

The natural characteristics of a watershed influence the hydrology and water quality of its streams, lakes and reservoirs. Natural characteristics such as subbasins, topography, geology, soils, and vegetation are considered when determining watershed protection measures

Subbasins

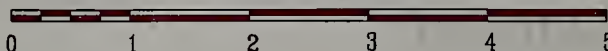
BWM has subdivided the Wachusett Reservoir watershed into 49 smaller subwatersheds (see **Figure 2-1**). The smaller subwatersheds are manageable units for administering watershed protection programs, identifying problems, and implementing solutions.



Subbasin Delineation Wachusett Reservoir Watershed



Statute Miles



Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management



Figure: 2-1

Topography

The Wachusett Reservoir, Quabbin Reservoir, and Ware River watersheds are mainly hilly, but also encompass flatter wetlands and flood plains, as well as some mountainous terrain with exposed bedrock. The Wachusett Reservoir and Ware River watersheds have broader valleys and more wetlands compared to the Quabbin Reservoir watershed, which has narrower valleys and steeper slopes, especially on the western side, where two mountain ranges run from north to south.

Elevations in the watersheds vary from 395 feet above sea level at Wachusett Reservoir to about 2,000 feet at Wachusett Mountain (MDC, et al., 1991a-b). The watersheds include scattered areas – 14% of the Wachusett Reservoir watershed, 18% of the total watershed system – with steep slopes greater than 15%.

Geology

Most of the uplands in the watershed system are covered with glacial till deposits several feet deep. Lowlands and valleys are usually filled with stratified glacial outwash deposits of silt, sand and gravel, and occasionally with swamp deposits of muck and peat. Depth to bedrock is variable – bedrock outcrops are commonly observed on the top and sides of hills, but bedrock also tends to be found at depths of up to 100 feet (MDC, et al., 1991a-b; MDC, et al., 1998).

Soils

The predominant soils found in the Wachusett Reservoir watershed are Hinkley-Merrimack-Windsor, Paxton-Woodbridge-Canton and Chatfield-Hollis. Additional soil types are found in the upper watershed, including soils in the Peru, Marlow, Montauk, Ridgebury, and Whitman series, as well as Bucksport and Wonsqueak mucks. Many of these soils are well drained to excessively well drained, including the Hinkley-Merrimack-Windsor soils on outwash plains, and the Canton and Chatfield-Hollis soils on uplands. These soils occur on gently sloping to moderately steep areas and are very deep, except for Chatfield-Hollis soils, which typically have a depth to bedrock of only a few feet. Other soils are poorly drained, including the Paxton-Woodbridge, Peru, Marlow, Montauk, Ridgebury and Whitman soils, as well as the Bucksport and Wonsqueak mucks. The permeability of most of these soils is limited by a substratum present a few feet below the surface, except for Bucksport and Wonsqueak mucks, which are organic soils. Some of these soils occur in depressions and low flat areas in uplands and frequently contain water, including the Ridgebury, Whitman, Bucksport, and Wonsqueak soils; yet others occur in gentle to strongly sloping areas throughout the watershed, including the Paxton-Woodbridge, Peru, Marlow, and Montauk soils (MDC, et al., 1998).

Erosion Potential

The soils in the watershed system appear to have a low to moderate erosion potential. The predominant soils in the Wachusett Reservoir watershed have K factors ranging from 0.10 to 0.32 out of a possible range of 0.03 to 0.69, where higher values indicate higher erosion potential (MDC, et al., 1998). Soil erosion is only likely to be a problem in areas where slopes are greater than 15% or where vegetation has been disturbed. Because the great majority of the watersheds is forested and has slopes less than 15% (82% of the total watershed system and 86% of the Wachusett Reservoir watershed), the extent of erosion prone areas is limited.

Areas with higher erosion potential in the Wachusett Reservoir watershed are located near much of the Stillwater River; on Rowley, Ross, and Justice Hills in Sterling; and on much of the land south of Route 110 near the reservoir. Erosion has only been significant in a few locations: the area affected by the 1989 tornado, where vegetation was severely disturbed, and the steep bluffs on the east shore of the reservoir, where steep slopes coincide with thin vegetation and strong winds. Revegetation and slope protection techniques have been used in these locations to reduce erosion. No significant problems have occurred on erosion-prone areas that border tributaries (MDC, et al., 1998).

Septic Tank Suitability

According to the USDA Natural Resources Conservation Service, most soils in the Wachusett Reservoir watershed are not well suited for the disposal of wastewater through septic tanks. Many soils that are well drained to excessively well drained tend to drain effluent too quickly to effectively filter it. On the other hand, soils that are poorly drained are not well suited to contain septic tanks because they have slow permeabilities and water is usually present near the surface (MDC, et al., 1998).

The unsuitability of soils, however, can be overcome through the careful design and siting of septic systems. Septic tanks that conform with Title 5 regulations, which were significantly revised in 1995, should not present a threat to the quality of groundwater. While most septic systems in the watershed predate the 1995 Title 5 regulations, the regulations require that substandard septic systems are gradually brought into compliance through inspections at the time of sale. In addition, systems that “fail” or cause surface breakouts are required by the Boards of Health to be repaired to meet the Title 5 regulations standards. **See Section 6.1** for a detailed discussion of septic systems.

Vegetation

Vegetative cover in the watersheds consists primarily of hardwood forest (deciduous trees such as maples, birches, ashes and oaks) and hardwood forest mixed with softwood forest (evergreen trees such as pines, hemlocks and spruces) with some scattered areas of cultivated land (corn, apples, hay) and wetlands. A large portion of the forested lands in the watershed are either owned by BWM or are otherwise protected (**see Section 2.2 and Section 4**). BWM lands in the Wachusett reservoir watershed are estimated to be approximately 54% hardwood forest, 33% softwood forest, and 13% other land types, such as open fields. These lands have been actively managed for about 50 years, including thinning, cutting and planting for forest diversity and water quality (**see Section 4.2.3**).

2.2 Land Use and Development

Key Points

- The Wachusett Reservoir watershed is sparsely developed, with 70% of the land covered by forests and wetlands. Over half of these forested lands are protected, with 29% directly owned or controlled by the BWM.
- Current development remains lowest in the Quabbin Reservoir watershed and increases easterly to the Wachusett Reservoir watershed. The developed areas are primarily low-density residential, with commercial and other developed land uses less significant. Areas of higher housing density and commercial activity tend to be located near the town centers and along major roads.
- Over the next 20 years, it is expected that the majority of development will be for residential uses with the gradual conversion of some unprotected forested land into low-density residential use.

Land use and development patterns in a watershed also influence the hydrology and water quality of its streams and lakes/reservoirs, and are important considerations to determine the appropriate protection measures for the watershed. Land use and population density for the Wachusett Reservoir watershed is shown in **Table 2-1** and a land use map is presented in **Figure 2-2**.

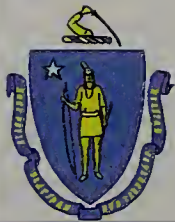
Table 2-1
Current Land Use and Population Density
Wachusett Reservoir Watershed

Land Use (%) Excluding the Reservoir ¹							Persons/ sq. mi.
Forest	Wetland	Agriculture	Residential	Commercial/ Industrial	Open Water	Other	
63.0	6.8	7.2	8.2	0.6	8.0	6.2	253

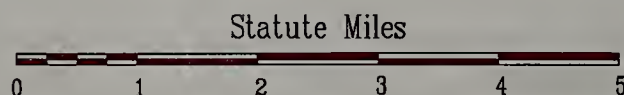
Source: MassGIS, 1999; U.S. Census, 2002

¹ The Wachusett Reservoir surface area, when full, is 4,122 acres, which represents 5.5% of the entire watershed area.

According to 1999 information provided by MassGIS, the primary land use remains undeveloped forested land. Residential and agricultural land use is not uncommon; commercial, industrial, and other land uses (highways, waste disposal, and recreation) are less significant in the watershed. Residential land use is primarily low density, although significant areas of medium density development do exist near town centers. The commercial areas tend to be located near the town centers and along major roads. The subbasins with the most development within the Wachusett Reservoir watershed are Scarlett, West Boylston and Gates (CDM, 1998). These subbasins are located in the southeastern part of the watershed, along Gates Brook and West Boylston Brook; less than 50% of each of these subbasins remains undeveloped. In contrast, Justice Brook subbasin at the northern end of the watershed is 92% undeveloped forest, water, or wetland.



Land Use / Land Cover Wachusett Reservoir Watershed



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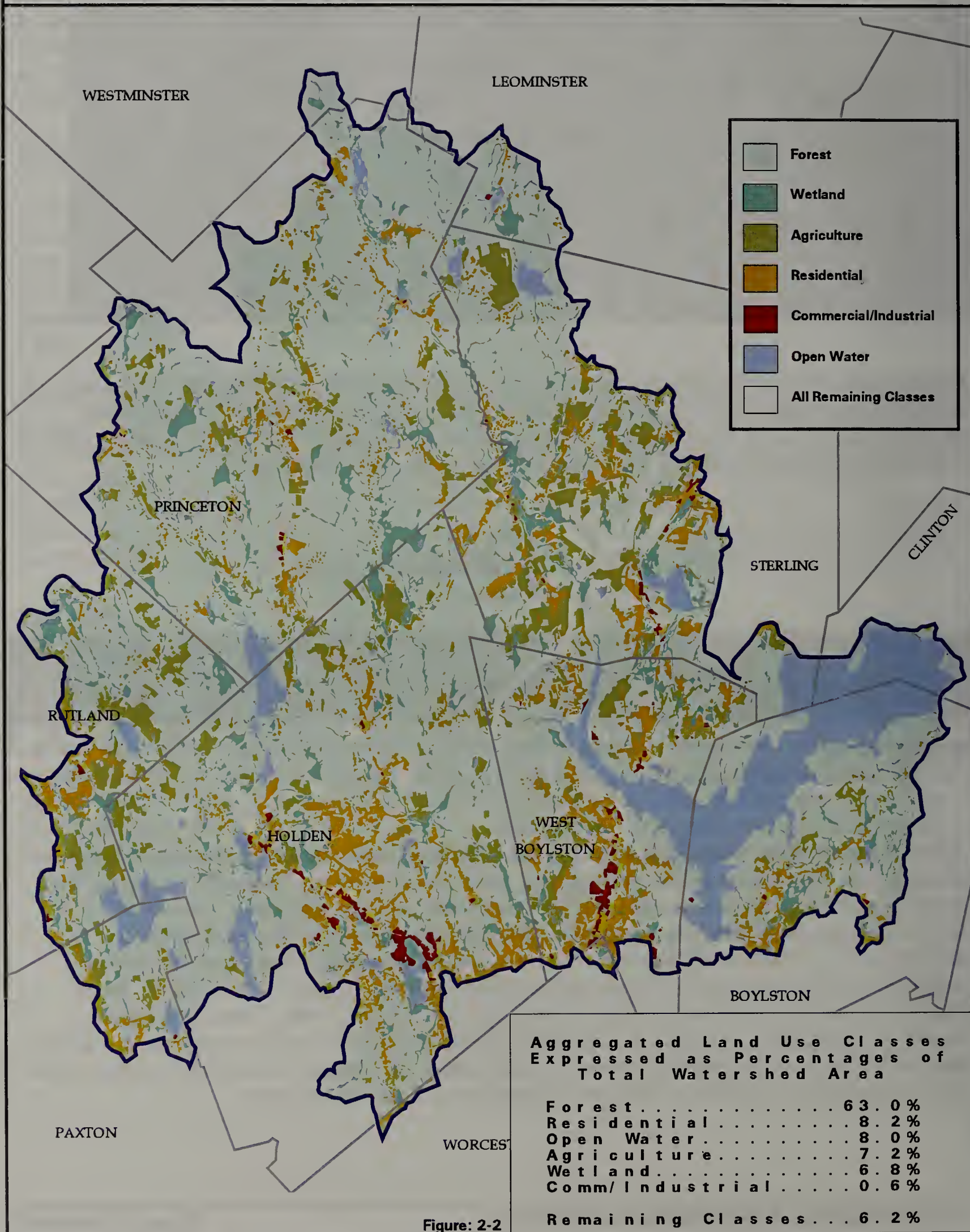


Figure: 2-2

Comprehensive Environmental Inc. inventoried agricultural sites for DWM in 1997. These sites included dairy/livestock farms (varying from several medium-size dairy farms to sites with two to ten animals), grazed land (pastures where livestock roam), and a variety of crop farms (orchards, truck crops, field crops, nurseries, Christmas tree farms) (CEI, 1997). The list is being field checked and updated as part of the Environmental Quality Assessment program described in Section 5.3. Agriculture is no longer considered a significant threat in the watershed due to the cumulative impact of acquisition, remediation, assistance, and farm abandonment; most remaining uses are smaller, “hobby farm” operations. **Section 6.4.2** presents a full description of agriculture in the Wachusett Reservoir watershed.

Overall, the BWM owns and/or controls about 29% of the Wachusett Reservoir watershed, exclusive of the reservoirs themselves (**see Section 4.1**). The Wachusett Reservoir surface area, when full, has a surface area of 4,122 acres, which represents 5.5% of the entire watershed area. Other state agencies, non-profit land conservation organizations, and municipalities own and protect another 14% of the watershed. Private property enrolled in the Chapter 61 tax abatement program, which helps foster private forestry, agriculture and recreation but is not a permanent form of protection, accounts for 10% of the watershed area (**see Section 4.3**). An additional 17.4% of the most sensitive areas in the Wachusett Reservoir watershed are jurisdictional under the Watershed Protection Act (WsPA); while these lands are still able to be developed, the BWM has the ability to review and minimize the impact of proposed projects located within these critical resource areas (**see Section 5.2.1**).

Table 2-2
BWM and Other Protected Open Space
Wachusett Reservoir Watershed

Year	Open Space as % of Watershed ¹			WsPA Protection ⁴
	BWM Owned or Controlled ²	Other Protected ³	Total Protected	
2003	29%	24%	53%	17%
1998	26%	26%	52%	17%

Source: BWM GIS, 2003

¹ Watershed area excluding reservoir surface. The Wachusett Reservoir surface area, when full, is 4,122 acres, which represents 5.5% of the entire watershed area.

² Includes lands owned in fee, Conservation Restrictions, and land under Care and Control Agreements.

³ Includes lands owned by other state agencies, local governments, private entities and those enrolled in the Chapter 61 program.

⁴ WsPA protected areas include some acreage that is enrolled in the Chapter 61 program or is protected by private entities.

The Wachusett Reservoir watershed is mostly undeveloped, with much of the forests and wetlands either owned by the BWM or otherwise protected. Forested land which is currently not owned by the BWM or preserved by state or local governments or by private entities (approximately 26% of the Wachusett Reservoir watershed) could be developed in the future for residential, commercial, industrial or other land uses if permitted by zoning laws.

The potential for development of this unprotected land depends on many social and economic factors, including development pressure, the need or willingness of current owners to sell their land, and population growth. Information on population growth and projections is shown in **Table 2-3**.

Table 2-3
Population Growth and Projections
Wachusett Reservoir Watershed Communities

TOWN	1990 Population	2000 Population	% Change 1990 – 2000	2010 Population (Projected)
Boylston	3,517	4,008	14%	4,232
Holden	14,628	15,621	7%	16,928
Paxton	4,047	4,386	8%	4,617
Princeton	3,189	3,353	5%	3,517
Rutland	4,936	6,353	29%	7,365
Sterling	6,481	7,257	12%	7,655
W. Boylston	6,611	7,481	13%	7,749

Sources: US Census data from MA MISER, 2003; 2010 population projections from Central Massachusetts Regional Planning Commission and MA MISER (Sterling only), 2003.

Most of the undeveloped land is currently zoned for low density residential use (1 - 2 acre minimum lot size). Commercial- and industrial-zoned lands represent a very small proportion of the watersheds, and tend to be located near the town centers and major roads. No major development in the watersheds is expected to occur in categories such as waste disposal, recreation, or major highways. Future development in the watershed is expected to involve the gradual conversion of some unprotected forested land into low-density residential land. Recently, however, there has been a new trend in residential development. During the last few years the construction of housing intended for those people aged 55 and over has become very popular. In fact, one watershed town has seen the construction of two “over 55” housing projects and more are proposed. As the population ages, that trend is expected to continue and perhaps expand into other watershed towns.

The number of single family dwelling building permits issued over the past five years varies throughout the watershed (see **Table 2-4**). The percentage each town comprises of the watershed, as well as how much of each community is actually in the Wachusett Reservoir watershed is also presented in Table 2-4.

Table 2-4
New Single Dwelling Building Permits Issued by Town

Town	% of Watershed	% of Town in Watershed	1998	1999	2000	2001	2002	Total
Boylston	9%	56%	20	22	12	13	23	90
Holden	25%	82%	68	69	84	54	95	370
Paxton	3%	19%	19	19	17	19	18	87
Princeton	25%	82%	11	12	13	14	15	65
Rutland	8%	24%	76	71	74	74	74	362
Sterling	16%	58%	65	54	42	45	48	254
West Boylston	11%	92%	15	19	3	7	37	72

Sources: Individual Town Reports, 1998 – 2002

2.3 Hydrology

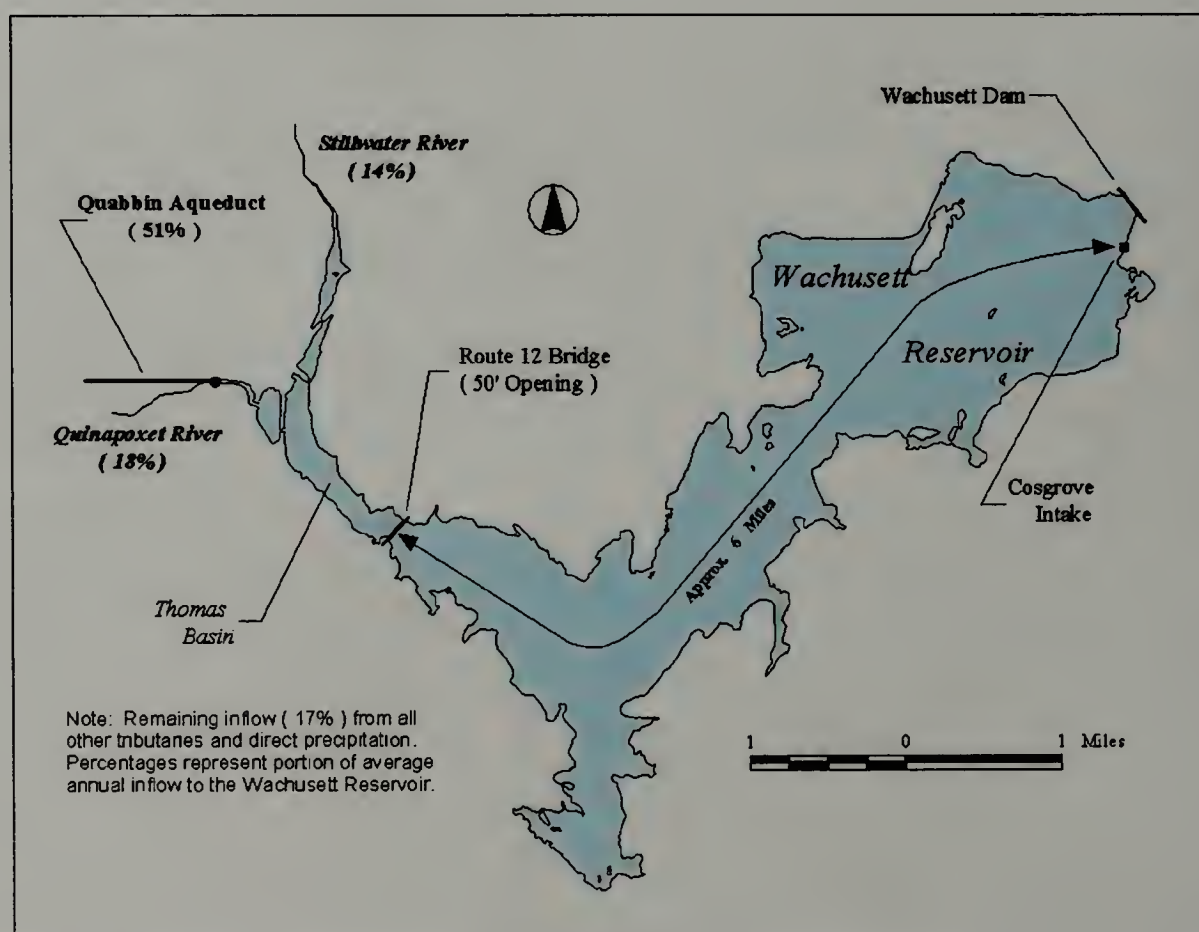
Key Points

- Wachusett Reservoir is an impoundment of the Nashua River completed in 1908 as a public water supply for Boston. It measures 6.1 square miles (15.8 square kilometers) in surface area with a capacity of 66 billion gallons (250 million cubic meters) of water. Today, in conjunction with Quabbin Reservoir located approximately 25 miles to the west, Wachusett Reservoir provides water to 2.2 million residents of Greater Boston.
- Wachusett Reservoir receives more than 50% of its annual inflow from the Quabbin Reservoir. Inflows from Wachusett Reservoir's two main tributaries account for another 30% of its annual inflow.
- The elongated shape, large size and depth of Wachusett Reservoir results in long detention times, and significant dilution and settling of tributary inflows. Almost 90% of the total annual inflow to Wachusett Reservoir enters the reservoir at or above Thomas Basin, a narrow basin reservoir bounded on its lower end by the Route 12 bridge, as shown in **Figure 2-3**.
- The reservoir is subject to seasonal effects, mixing completely between the late fall and spring, and developing complete ice cover during most winters. The reservoir becomes thermally stratified in the summer as is typical of most deep temperate water bodies.
- Transfers from Quabbin Reservoir are colder and denser than Wachusett Reservoir surface water and follow a metalimnetic flow path ("Quabbin interflow") during stratified conditions that dramatically reduces the time it takes this higher quality water to reach the Cosgrove Intake (3 to 5 weeks). Transfers that are initiated prior to the development of strongly stratified conditions take longer to reach the Cosgrove Intake, but still less than would be expected from the reservoir's average residence time (6 months).
- Streamflow in the Wachusett Reservoir watershed has significant seasonal changes. Flows tend to be highest in the spring, due to snowmelt and high groundwater; and lower in the summer and early fall. Streamflow also varies in response to rainfall events, being several times higher than baseflow during storms.

The Quinapoxet and Stillwater Rivers are the major tributaries to Wachusett Reservoir accounting for 42 and 33 percent respectively of total watershed inputs exclusive of inflows from Quabbin Reservoir (see **Figures 2-3 and 2-4**). The DEP regulatory Zones A (400' around the reservoir and 100' around tributaries), Zone B (an additional half-mile around surface water reservoirs) and Zone C (the remaining watershed) are shown in Figure 2-3. Taking into account only watershed drainage and precipitation, the reservoir flushing rate is about two years. However, with the hydrologic budget enhanced by water transferred annually from Quabbin, the flushing rate of Wachusett Reservoir is reduced to approximately one year.

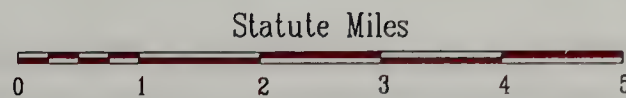
The Thomas Basin is an important reservoir feature that helps preserve high water quality. The basin is just upstream of the reservoir, separated from the reservoir by the Route 12 causeway. The causeway constricts the channel width from 1000 feet to approximately 50 feet. Most of the inflow to the Wachusett Reservoir (approximately 90%) passes through the Thomas Basin, including Quabbin transfers and Stillwater and Quinapoxet River inflows (see **Figure 2-3**). Under normal tributary flow conditions (non-storm and Quabbin not transferring), the residence time in the basin can be on the order of several weeks. The residence time in Thomas Basin when water is being transferred from Quabbin Reservoir is about four days, which is still a sufficient period of time to allow the settling of solids present from the tributaries. Thomas Basin is thus an effective sedimentation basin for inflowing solids and their adsorbed contaminant load (e.g., nutrients, bacteria, and possibly pathogens). While the turbidity of the inflowing streams is already low, the reduction of solids load (estimated to be 85 to 90% of entering solids) certainly contributes to the high quality of water in the main body of the reservoir (CDM, 1995).

Figure 2-3: Major Inflows to Wachusett Reservoir





Surface Water Supply Protection Areas Wachusett Reservoir Watershed



Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management

■ Zone A Protection Area

■ Zone B Protection Area

— Watershed Boundary

— Municipal Boundary

— Major Roads

Zone C consists of all land within
the Wachusett Reservoir watershed
that is not in Zone A or Zone B.

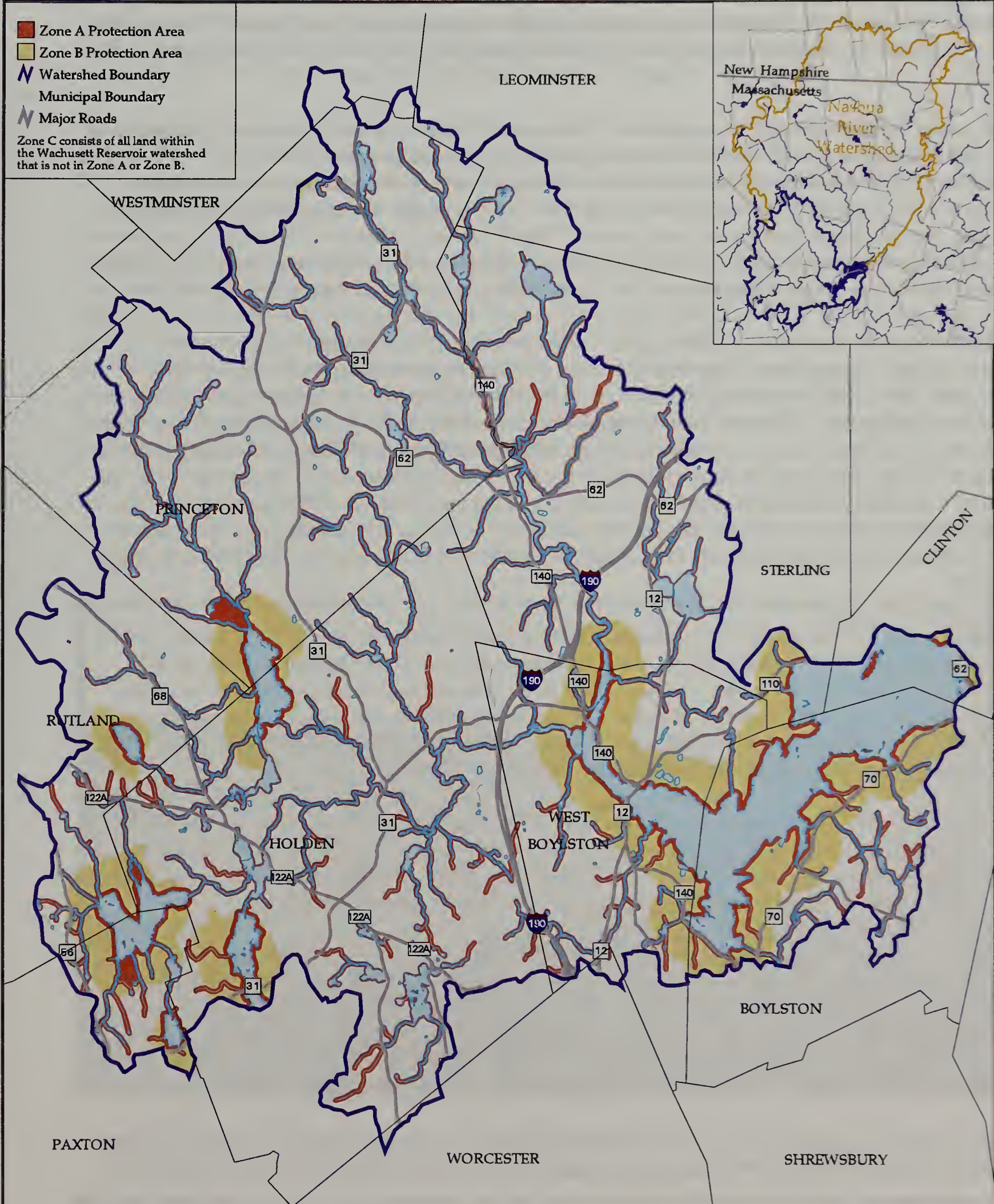
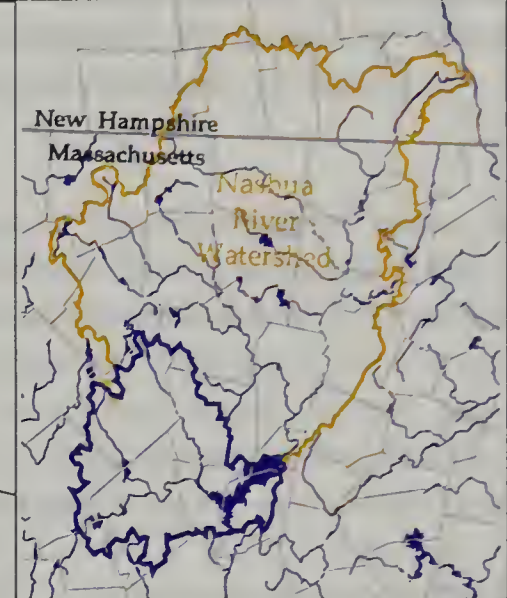


Figure: 2-4

Typical of most deep lakes and reservoirs in the temperate region, Wachusett Reservoir becomes thermally stratified in summer. As summer wanes, heat loss causes thermal gradients to weaken leading to fall “turnover” around the end of October when wind energy mixes the entire water column. Ice cover develops almost every year, usually between January and March. After ice-out, the water column undergoes another period of mixing until the onset of thermal stratification in late April.

The annual transfer of water from Quabbin to Wachusett Reservoir via the Quabbin Aqueduct has a profound influence on all functional characteristics of Wachusett Reservoir including hydrodynamics, annual hydrologic and nutrient budgets, and stratification structure. During the years 1995 through 2002, the amount of water transferred annually from Quabbin to Wachusett ranged from a volume equivalent to 44 percent of the Wachusett basin up to 94 percent. The period of peak transfer rates generally occurs from June through November. However, at any time of the year, approximately half of the water in the Wachusett basin is derived from Quabbin Reservoir.

A hydrodynamic phenomenon known as the “interflow” occurs each summer in Wachusett Reservoir as a consequence of the annual transfer of water from Quabbin Reservoir. Water withdrawn from the Quabbin hypolimnion is colder and denser relative to epilimnetic waters in Wachusett Reservoir. However, after being discharged at Shaft 1, the transfer water gains a slight amount of heat from mixing as it passes through Quinapoxet Basin and Thomas Basin and is not as cold and dense as the hypolimnion of Wachusett. Therefore, Quabbin water transferred during the period of thermal stratification flows conformably into the metalimnion of Wachusett where water temperatures and densities coincide. The term interflow describes this metalimnetic flow path for the Quabbin transfer that generally forms between depths of 7 to 15 meters in the Wachusett water column.

Quabbin interflow water quality is distinctive from ambient Wachusett water having lower specific conductivity and lower concentrations of all nutrients characteristic of Quabbin Reservoir; the interflow is conspicuous in water column profile measurements as a metalimnetic stratum of low conductivity. Profile data confirm that the interflow is a gravity-driven phenomenon spreading through the metalimnion into all portions of the basin having sufficient depth including South Bay, Andrews Harbor, west of Cemetery Island, and against the dam.

Analysis of timing and volumes required for interflow penetration based on recent transfers from Quabbin indicate that it takes about 3 to 5 weeks and from 5.5 to about 7.8 billion gallons of transfer discharge for the interflow to reach Cosgrove Intake; the rate of interflow penetration through the reservoir system depends on the timing and intensity of transfer from Quabbin.

In addition to forming the interflow, Quabbin transfer water spreads out over the bottom of Quinapoxet Basin and Thomas Basin as a cold, dense underflow. Eventually this underflow displaces most of the volume in these basins except for a relatively thin surface layer of warm water derived from tributary runoff. Profile data demonstrate that this “basement” stratum of cold water can penetrate “upstream” into the upper reaches of the reservoir system as far as the railroad bridge that forms the bottleneck between Stillwater Basin and Upper Thomas Basin.

During periods of peak transfer, a remarkable manifestation of strong Quabbin underflow moving through Thomas Basin into the main basin becomes evident at the bottleneck formed by the Route

12 Bridge. The cold underflow through this bottleneck induces a counter-current of warm surface water moving from the main basin “upstream” back into Thomas Basin. Profiles recorded downgradient of the Route 12 Bridge indicate that the underflow exiting Thomas Basin becomes an interflow spreading out over colder ambient water upon reaching a location in the main basin where depths are sufficient to accommodate hypolimnetic extremes of water temperature and density (approximately 250 meters downgradient of the Route 12 Bridge).

Once established, the interflow essentially connects Quabbin inflow to Cosgrove Intake in a metalimnetic “short circuit” undergoing minimal mixing with ambient Wachusett Reservoir water. The interflow stratum exhibits a thermal gradient characteristic of its metalimnetic position and separates ambient Wachusett water composing the epilimnion and hypolimnion.

Summary information on morphology, precipitation, inflows, and outflows can be found in the previous Watershed Protection Plan Update (MDC, et al., 1998). Weekly flow data for a number of tributaries are available in the annual Water Quality Reports published by the BWM each spring (MDC, 1999c; MDC, 2000a; MDC, 2001b; MDC, 2002f; MDC, 2003). A thorough description of the “Quabbin interflow” and its impact on reservoir water quality can be found in a recently published summary of nutrient and plankton dynamics in Wachusett Reservoir (MDC, 2003a). Time-of-travel maps for baseflow and stormwater conditions were developed as part of the *Wachusett Watershed Stormwater Management Plan* (CDM, 1998).



2.4 Water Quality

The main goal of watershed protection is to maintain a high water quality in the supply reservoirs, which depends on many watershed features, including: natural characteristics, land use and development, and hydrology. The previous sections provided an overview of these factors. This section provides a summary of the water quality in Wachusett Reservoir and the tributaries with a particular focus on fecal coliform bacteria, *Giardia* and *Cryptosporidium*, nutrients, plankton, and biomonitoring.

Key Points

Reservoirs

- A high quality and reliable source of drinking water, Wachusett Reservoir has crystalline water with low turbidity, bacterial counts, plankton densities, and nutrients.
- The reservoir has met SWTR source water quality criterion for unfiltered systems since July 1993.
- The detection of *Giardia* and *Cryptosporidium* at the reservoir intake and at Wachusett Reservoir's other sampling locations has been very low. More than 96% of total samples have been below the detection limit for *Giardia* and *Cryptosporidium* since March 1995.
- Major findings of nutrient and plankton monitoring conducted since 1998 include marked seasonal and vertical variations in nutrient concentrations mediated by phytoplankton dynamics, shifts in nutrient concentrations and the intensities of other parameters corresponding to the timing and magnitude of the annual water transfer from Quabbin Reservoir, and an annual cycle of phytoplankton succession and abundance characteristic of many temperate, oligotrophic systems.
- The macrophyte flora of Wachusett Reservoir has been characterized. The alien species posing the greatest potential threat to water quality is Eurasian Water-milfoil (*Myriophyllum spicatum*) and it has been the focus of intensive control efforts since 2002.

Tributaries

- Wachusett tributaries for the most part have clear water with low bacterial counts and nutrient levels. Biomonitoring of insect populations has shown that the biota present are generally indicative of healthy ecosystems and intolerant of pollution.
- Turbidity and fecal coliform bacteria in the tributaries fluctuate in response to storm flows and other conditions. Wachusett tributary fecal coliform bacteria spikes can affect the upper ends of the reservoirs, but do not impact water quality near the reservoir intake. In the Wachusett Reservoir, 90% of tributary inflows enter the reservoir at Thomas Basin, which through sedimentation and the long travel time to the intake allows bacteria to die off or disperse in surrounding waters.
- While the overall detection of *Giardia* and *Cryptosporidium* in the Wachusett Reservoir watershed was higher than at the intake, it is considered relatively low, especially because some watershed sample stations have been deliberately located in problematic rather than typical areas of the watershed. The lower pathogen incidence at the intake locations suggests that there may be attenuation of pathogen levels through in-reservoir processes such as dilution, settling, predation or die-off.
- Some tributaries in the Wachusett Reservoir watershed have elevated nitrate levels, but these tributaries are small and only contribute a minor portion of the total annual nitrate load to the reservoir. Phosphorus levels in the tributaries are very low.

There has been a significant amount of water quality data collection from Wachusett Reservoir and the tributaries. The BWM runs a comprehensive, ongoing monitoring program, which is described in Section 5. In 1995, DWM and MWRA established a regular monitoring program for pathogens, which was supplemented in 1997 with data collected to comply with EPA's Information Collection Rule (ICR). The DWM reviewed ten years of tributary water quality data (1988-1997) and published a summary report (MDC, 1999b); annual water quality reports are published as well every spring. Summaries of water quality data at the subbasin level are included in each of the three Environmental Quality Assessment Reports currently available from the BWM (MDC, 2002a; MDC, 2003; MDC, in press). Two comprehensive summary reports describing plankton populations and nutrient dynamics in the Quabbin and Wachusett Reservoirs have also been recently published (MDC, 2002d; 2003a). A general assessment of water quality is provided below; detailed information can be found in the reports listed above.

There are two regulatory requirements that relate to fecal coliform bacteria levels in Wachusett Reservoir. The SWTR requires that fecal coliform bacteria in the source water of unfiltered systems meet the following standard: at least 90% of the samples collected in the previous 6-month period must have levels less than 20 colonies per 100 mL. The Massachusetts Water Quality Standards require that fecal coliform bacteria in reservoir or tributary waters with Class A designations not exceed an arithmetic mean of 20 colonies per 100 mL, nor 10% of the samples exceed 100 colonies per 100 mL.

Table 2-5 summarizes fecal coliform data collected by BWM in recent years, in terms of medians and the percentage of samples that exceed the 20 colonies per 100 mL threshold for unfiltered surface water supplies. The Wachusett Reservoir has very low median bacterial counts, and rarely exceeds the 20 colonies per 100 mL threshold. The reservoir meets the SWTR requirement for unfiltered systems, as shown in **Figure 2-5**. Although fecal coliform bacteria levels at Wachusett were higher prior to 1993, the levels have dramatically dropped due to BWM efforts and have complied with the limit since July 1993. Both the frequency and the magnitude of the exceedances of the 20 colonies per 100 mL trigger have declined. In the past, the highest coliform levels in Wachusett Reservoir, occurring in the winter, were associated with the presence of roosting gulls on the reservoir. As BWM's gull harassment program has been implemented effectively and roosting gulls were relocated, both the roosting gull population and fecal coliform bacteria levels declined. Summer concentrations of fecal coliform bacteria, historically much lower than winter levels, have also decreased.

Monitoring of tributary water quality is not required by the SWTR or other regulations. BWM conducts extensive monitoring of tributaries as a tool to identify subbasin areas requiring special attention for watershed management activities, as well as to track overall water quality and identify any trends, including improvements resulting from watershed actions. **Table 2-5** summarizes fecal coliform bacteria data in all tributaries annually over the past ten years, while **Table 2-6** summarizes fecal coliform bacteria data in each of ten tributaries during the same ten year period. In both tables an overall decline in fecal coliform bacteria concentrations in the tributaries is apparent. Both median values and the percentage of samples exceeding 20 colonies per 100 mL were lower during the past five years, and water quality appears to be improving.

Table 2-5
Fecal Coliform Bacteria Levels for Wachusett Reservoir Watershed
1993 – 2002

Year	Tributaries		Reservoir	
	Annual median	% samples > 20/100 mL	Annual median	% samples > 20/100 mL
1993	20	49%	4	17%
1994	23	53%	1	7%
1995	20	49%	3	8%
1996	24	55%	2	1%
1997	20	48%	2	5%
1998	18	47%	2	2%
1999	15	43%	1	5%
2000	12	40%	1	<1%
2001	20	50%	0	1%
2002	20	42%	1	<1%

Source: BWM Wachusett EQ Section, 2003

Table 2-6
BWM Wachusett Tributary Fecal coliform bacteria Data (1993-1997 and 1998-2002)

Tributary	Annual Flow into Wachusett Reservoir (%) ¹	Fecal Coliforms/100 ml			
		1993-1997		1998-200	
		Median	%>20	Median	%>20
Gates	1.3	26	59	20	45
French	0.9	17	47	10	38
Malagasco	0.5	46	56	26	51
West Boylston Br.	<0.5	72	82	40	61
Muddy Brook	<0.5	13	39	10	35
Boylston Brook	<0.5	8	33	12	38
Quinapoxet River	18	17	44	17	46
Stillwater Brook	14	30	55	20	49
Malden	0.6	22	51	20	45
Justice Brook	*	2	11	2	5

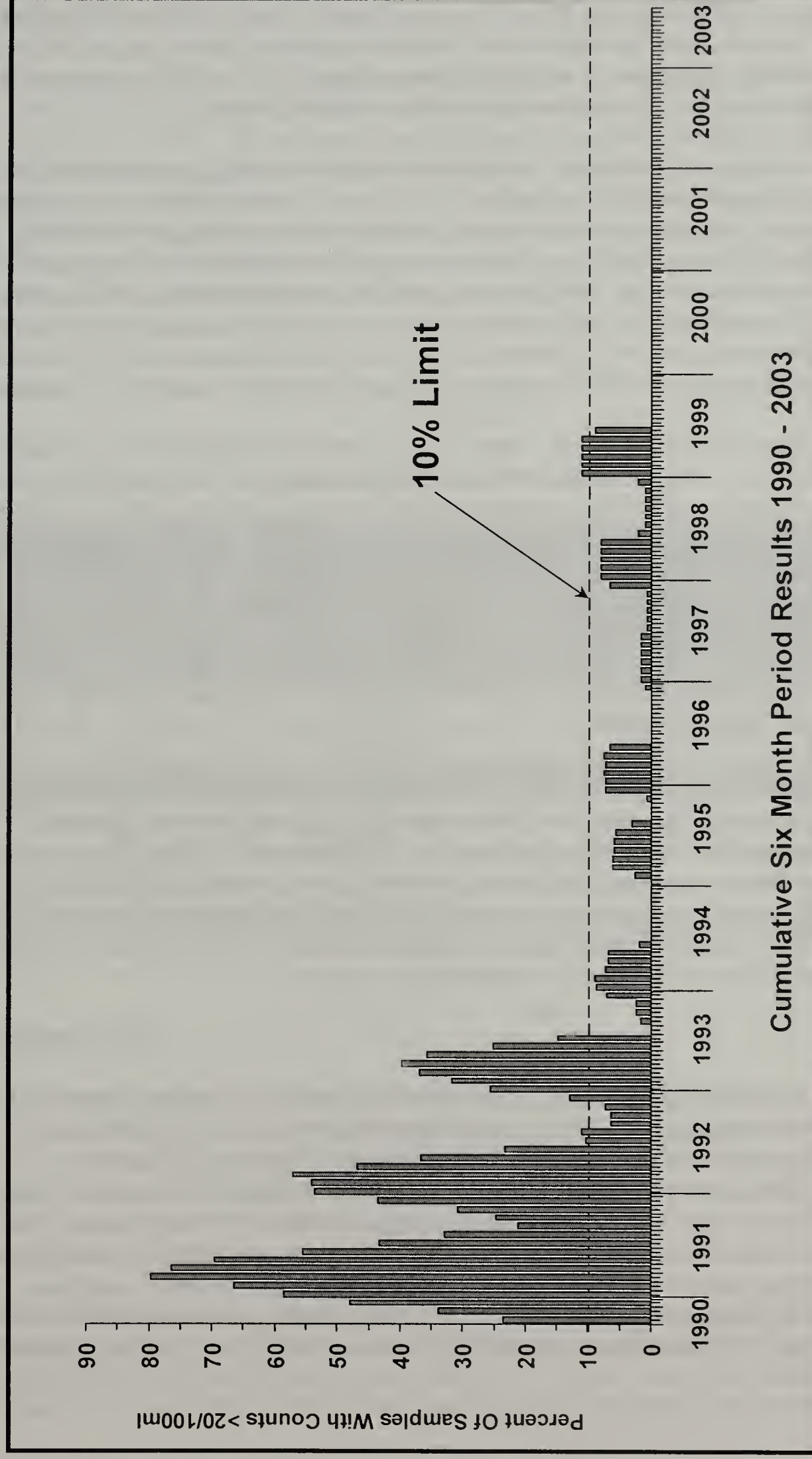
Source: BWM Wachusett EQ Section, 2003

* Tributary of Stillwater which contributes ~1-4% annual flow.

¹ Remainder of flow comes from Quabbin Reservoir.

The tributaries have relatively low fecal coliform bacteria median values, though they remain higher than the reservoir. Fecal coliform bacteria averages tend to be higher than the medians, and exceed

**Figure 2-5: Fecal Coliform Bacteria Sampling Results At Wachusett Reservoir May 1990 Through July 2003
(Cosgrove Intake)**



Source: BWM Wachusett EQ Section and MWRRA, 2003.
NOTE: Lack of a bar on this table represents 0% of samples with counts > 20/100 ml.

the Class A standard of 20 colonies per 100 mL in most streams. Fecal coliform data exhibit a great deal of variability, especially during storm events, and concentrations can rise by several orders of magnitude. High average values and low median values suggest that the high averages are due to these occasional storm-related spikes rather than sustained elevated levels.

Biomonitoring results support this theory. To supplement other water quality monitoring efforts, BWM has conducted biomonitoring in selected tributaries to Wachusett Reservoir. Biomonitoring involves collecting samples of insects from tributary streams and comparing the community structure observed with those of “reference” stations. It provides a description of long-term cumulative conditions in the streams. For the most part, insect biota observed in Wachusett tributaries are intolerant of pollution and indicative of healthy ecosystems, comparable to biota observed at the reference stations within the watershed. Only stations on two small tributaries (Gates and Malagasco Brooks) exhibited significant impacts potentially caused by contamination during the 1990s.

More recent samples were collected during 1998 and 2001, although the 2001 samples have not yet been identified. A number of tributaries continued to have very good water quality as assessed by macroinvertebrate populations, with several showing improvements from earlier characterizations. Gates Brook sampled near the reservoir was only moderately impacted, the best assessment since 1990; an upstream station, however, remained severely impacted. Malagasco Brook also remains severely impacted and source investigation continues.

2.4.1 *Giardia* and *Cryptosporidium*

Even though testing for *Giardia* and *Cryptosporidium* is not required by EPA or the MA DEP, BWM and MWRA continues sampling for *Giardia* and *Cryptosporidium* in the watershed, reservoirs, and transmission system. Testing began on a periodic basis in 1988, using the most current methods available at the time. The test results for *Cryptosporidium* and *Giardia* are consistent with what would be expected: the highest levels found are at suspected sources upstream within tributaries of the watershed, then settling within the reservoirs, with very low levels found at the intake, and consistently low levels in the transmission system.

Watershed

CDM’s and MWRA/DWM’s initial testing efforts (February 1994 to June 1996) focused on familiarizing staff with sampling procedures and trying to “find” the organisms in the water sampled. For these reasons, the sites chosen were the most likely to have *Giardia* or *Cryptosporidium*, and over 20 different locations were sampled through the watersheds. Later sampling programs (July 1996 to present) focused on a smaller number of fixed stations. The Wachusett tributaries that are currently sampled are Gates Brook, a small tributary with areas of septic system problems, and French Brook, a small tributary with dense wildlife conditions. These tributaries are more representative of problematic areas rather than typical areas in the watershed. **Table 2-7** summarizes the *Giardia* and *Cryptosporidium* results for the Wachusett system since March 1995.

Source Water

MWRA's routine sampling started out with monthly samples at Cosgrove Intake and Chicopee Valley Aqueduct (CVA) Intake. Routine sampling is now weekly at the Cosgrove Intake and monthly at the CVA Intake. All samples at both intakes are currently analyzed by Erie County Water Authority laboratory, under contract to the MWRA. Each 100-liter sample is tested using the current EPA-approved ICR method. For July 1997 to August 2003, only 3 samples collected from Cosgrove Intake have been presumptive positive for the presence of *Giardia*. No samples have been confirmed positive. No samples have been presumptive or confirmed positive for *Cryptosporidium*. No samples have been presumptive or confirmed positive for *Giardia* or *Cryptosporidium* at the CVA Intake.

Table 2-7
Summary of Wachusett System Testing Results for *Cryptosporidium* and *Giardia*
(January 1998 - June 2003)

Location	# of Samples	# of Samples Below Detection Limit ²	% Below Detection Limit	# Confirmed Samples (internal structures)	% Confirmed	# Presumed Samples (empty or amorphous oocysts)	% Presumed
<i>Cryptosporidium</i>							
Intake/System	256	256	100.0%	0	0.0%	0	0.0%
Watershed ¹	100	76	76.0%	0	1.0%	23	23.0%
<i>Giardia</i>							
Intake/System	256	252	98.4%	0	0.0%	4	1.6%
Watershed ¹	100	48	48.8%	3	3.0%	49	49.0%

Source: BWM Wachusett EQ Section. 2003

¹ The data set of watershed samples include locations selected as worst-case or probable pathogen sites (Gates Brook, French Brook) and the two primary tributaries entering the reservoir (Quinapoxet River, Stillwater River).

² Detection limits for most Intake/System samples are low, below 1.0 cysts per 100 Liters. The four presumed *Giardia* samples (empty or amorphous cysts) averaged 1.5 cysts per 100 Liters.

Transmission System

MWRA is currently engaged in a voluntary, joint research effort with Tufts University investigating levels of *Cryptosporidium* in drinking water using a new, highly sensitive test method. Since the routine, EPA-approved ICR method used by the MWRA has so few detects, no statistical comparisons were possible of human exposure to drinking water. As a result, MWRA and Tufts decided to use a more sensitive method to determine the variability, if any, of levels of *Cryptosporidium* and *Giardia*.

The research monitoring uses a weekly composite sample (some water each day for the entire week) of 1,000 liters at Shaft 9A, a site within the water system that is representative of water delivered to customers in the metropolitan Boston system. The water is filtered through an Idexx foam filter, and then analyzed. All *Cryptosporidium* oocysts, both confirmed and empty, are counted. This method,

using a large sample volume and an improved filter is more than 60 times more sensitive than the current EPA-approved ICR method used by MWRA.

The data collected so far is consistent with MWRA's past data. As was expected, the much higher sample volumes and the more sensitive testing have yielded some positive samples; 20 of 124 (16%) filters analyzed between May 2001 and October 2003 were positive for *Cryptosporidium*. All but one of these positives has been below the nominal detection limit of the ICR method (1-oocyst/100 liters), and the running average is around 0.05 oocyst/100 liters.

It is important to note that *Cryptosporidium* and *Giardia* monitoring has significant limitations. The tests do not clearly distinguish between live and dead cysts, cannot determine if an organism is in fact infectious to humans, and the infectious dose of various strains of *Cryptosporidium* is not well understood. For instance, 38 of the 43 *Cryptosporidium* samples recovered were empty oocysts, had no internal structures, and most likely not viable. Tufts has also tested for *Giardia* using the same testing method as above. In 66 samples taken from July 2002 to October 2003, there has been one positive.

BWM, along with the American Water Works Association Research Foundation, is also sponsoring a UMass research study to assess watershed runoff for pathogens (see section 8.4).

2.4.2 Viruses and Other Pathogens

Voluntary sampling for enteric virus samples began in 1994, continued with mandatory sampling under the Information Collection Rule (ICR) from 1998-1999, and now continues with voluntary sampling.

The initial work was completed by CDM with samples from the Wachusett Reservoir and watershed, and the Quabbin Aqueduct. From 1997-1998, as part of EPA's ICR, samples were taken at Cosgrove Intake. The approved method under this program is the ICR method for total culturable viruses. This method detects the presence of many viruses that may be associated with human infection, however there are also viruses detected by this method that are not of concern to humans. While this test does not prove the presence of viruses capable of causing infection in people, it does measure the presence of a group of enteric viruses commonly found in fecally contaminated waters and EPA believes these are at least somewhat representative of human pathogenic viruses. Under the ICR program, if virus levels exceeded 100 MPN/100 L, additional monitoring would have been required. Since 1998, MWRA has voluntarily continued to test for viruses using the ICR method above. From July 1997 through August 2003, 9 of 66 samples detected viruses at low levels, with an average of 0.3 MPN/100L.

Potential sources of pathogens to Wachusett Reservoir include: tributary inflows, transfers from other watersheds, and in-reservoir sources such as birds. According to the monitoring data, tributary inflows to Wachusett Reservoir appear to be a consistent source of pathogens. While the Wachusett Reservoir Water Quality: Interim Assessment (CDM, 1995b) evaluated fecal coliform bacteria fate and transport in Wachusett Reservoir, it is unclear how far the findings apply to pathogens compared with coliforms, since pathogens require a longer time to die-off or to settle (due to smaller size and

density). Monitoring data for the Wachusett system show that pathogen incidence since 1995 is lower in the intake/system than in the watershed. This difference suggests that there may be attenuation of pathogen levels through in-reservoir processes such as dilution, settling, predation or die-off. A detailed analysis to quantify the significance of attenuation due to in-reservoir processes has not been conducted.

2.4.3 Nutrients

A study of nutrient levels in Wachusett Reservoir has recently been completed (MDC, 2003a). The following conclusions were drawn; for additional details and explanation please refer to the published report.

- Results of nutrient monitoring conducted since 1998 confirm “oligotrophic” status (Wetzel, 1983) of Wachusett Reservoir based on low concentrations of total phosphorus and total inorganic nitrogen (this status is dependent on the Quabbin transfer functioning as the major hydrologic input); as an oligotrophic system Wachusett Reservoir provides high quality drinking water to consumers.
- The timing and duration of the annual transfer from Quabbin are the primary factors influencing nutrient concentrations in Wachusett Reservoir. Water quality within the reservoir basin reflects a dynamic interaction between the influence of the Wachusett Reservoir watershed and the influence of the Quabbin transfer. The Quabbin transfer is characterized by water of very low nutrient concentrations whereas the influence of the Wachusett Reservoir watershed is exerted mostly via the discharges of the Quinapoxet and Stillwater Rivers with higher nutrient concentrations. The interplay between these two influences causes the ranges of nutrient concentrations and parameter intensities to shift from one year to the next.
- Concentrations of all nutrients and patterns of seasonal fluctuation are similar across all sampling stations in the main basin of the reservoir (except for hypolimnetic values at Cosgrove Intake where mixing with the interflow caused by flow over a submerged dike obscures trends evident elsewhere). Temporary lateral gradients can become pronounced for certain parameters depending on the prevailing balance between the Quabbin transfer and watershed inputs.
- Concentrations of ammonia, nitrate, and silica exhibit marked seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (epilimnion and metalimnion) and decomposition of sedimenting phytoplankton in the tropholytic zone (hypolimnion).
- Ammonia and nitrate are depleted in the trophogenic zone in April and July respectively and remain below or near the detection limit of 5 µg/L through September, whereas concentrations of these nutrients increase in the tropholytic zone (ammonia increases in the hypolimnion from May through August and nitrate from May through fall turnover).

- Minimum concentrations of silica are measured in the trophogenic zone in July through September, whereas hypolimnetic concentrations increase from May through fall turnover.
- Concentrations of total phosphorus are low throughout the year at all stations and depths with levels generally ranging from 5 to 10 µg/L; this indicates that phosphorus is the limiting nutrient for Wachusett Reservoir phytoplankton.
- The Quabbin interflow generally forms between depths of 7 and 15 meters in the water column and its presence is evident as a metalimnetic stratum of low conductivity and also in the relatively low concentration ranges of nutrients in the metalimnion, especially nitrate, silica, and alkalinity.
- During the November through April period of water column isothermy and mixing, the water column is homogenized (no vertical gradients) with concentrations of most nutrients intermediate between summer extremes measured in the trophogenic and tropholytic zones.
- In Thomas Basin, concentrations and intensities of all parameters vary widely depending on the interplay between the Quabbin transfer and the Wachusett Reservoir watershed; during extended summer periods of transfer Thomas Basin is flushed out and essentially becomes an extension of the Quabbin hypolimnion with low nutrient concentrations, but at times when discharges from the Quinapoxet and Stillwater Rivers are the predominant loading sources (especially in spring before transfer initiation) nutrient concentrations shift to higher ranges.
- Interannual fluctuations in nutrient concentrations and parameter intensities occur throughout the main basin as a result of the divergent influences of the Quabbin transfer and the Wachusett Reservoir watershed; temporary lateral gradients across the basin can become pronounced for nitrate, silica, UV254, and conductivity either decreasing or increasing downgradient of Thomas Basin depending on the dominant influence.

Nutrient levels in the Wachusett tributaries are low as well, although considerably higher than in the reservoir. Concentrations measured from 1998 to the present are generally lower than historic values, but improved methods of analysis and lower levels of detection may have played a role in reducing average values. **Table 2-8** presents a summary of the nutrient data collected by DWM from 1998 to 2001 in the Wachusett tributaries. Average nitrate levels in the tributaries tend to be low except in West Boylston and Gates Brooks. The tributaries with high nitrate levels appear to have a minor effect on the reservoir water quality because they are small and contribute only a small portion of the annual nitrate load. Average phosphorus levels range from 0.028 mg/L to 0.063 mg/L among the Wachusett tributaries. Only Malagasco and French Brooks had an average in excess of 0.050 mg/L. **Table 2-9** presents data on nutrients in the Wachusett Reservoir.

Table 2-8
Tributary Nutrient Data Collected by BWM from 1998 to 2001

Tributary	Annual Flow %	Nitrate (mg/L)			Total Phosphorous (mg/L)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Gates	1.3	0.938	3.54	1.62	0.008	0.27	0.039
Malagasco	9.5	0.158	1.46	0.66	0.007	1.28	0.056
French	0.9	0.010	0.30	0.12	0.010	1.09	0.063
W. Boylston	<0.5	0.609	5.03	2.57	0.007	0.31	0.028
Muddy	<0.5	0.042	0.39	0.14	0.007	0.80	0.044
Quinapoxet	18	0.016	0.87	0.35	0.009	0.32	0.041
Stillwater	14	0.027	0.47	0.18	0.009	0.47	0.040
Malden	0.6	0.191	1.53	0.56	0.012	0.29	0.049

Source: BWM Wachusett EQ Section, 2003

Table 2-9
Wachusett Reservoir Nutrient Concentrations
Summary of Ranges 1998-2002

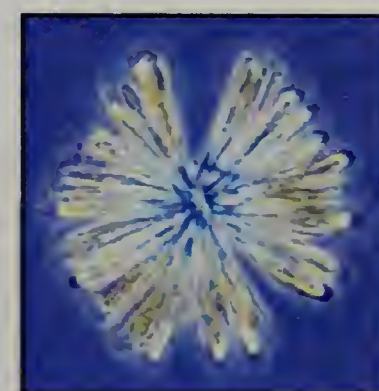
Sampling Station ¹	Ammonia (NH ₃ ; µg/L)	Nitrate (NO ₃ ; µg/L)	Silica (SiO ₂ ; mg/L)	Total Phosphorus (µg/L)	UV254 (Absorbance/cm)
Basin North/3417 (E)	<5 - 12	<5 - 124	0.59 - 3.02	<5 - 13	.032 - .068
Basin North/3417 (M)	<5 - 36	<5 - 138	0.77 - 3.31	<5 - 17	.032 - .079
Basin North/3417 (H)	<5 - 41	48 - 190	1.27 - 3.92	<5 - 14	.032 - .069
Basin South/3412 (E)	<5 - 14	<5 - 172	0.56 - 3.84	<5 - 17	.031 - .085
Basin South/3412 (M)	<5 - 26	11 - 184	0.95 - 4.03	<5 - 22	.032 - .089
Basin South/3412 (H)	<5 - 44	49 - 224	1.64 - 4.13	<5 - 37	.036 - .091
Thomas Basin (E)	<5 - 18	<5 - 201	0.62 - 5.00	<5 - 23	.026 - .140
Thomas Basin (M)	<5 - 18	<5 - 205	0.88 - 4.94	<5 - 22	.026 - .147
Thomas Basin (H)	<5 - 21	<5 - 236	0.92 - 4.99	<5 - 22	.027 - .150

Source: BWM Wachusett EQ Section, 2003. 1998-02 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling through December 2002, except for measurement of UV254 initiated in 2000 quarterly sampling.

¹ Water column locations key: E = epilimnion/surface; M = metalimnion/middle; H = hypolimnion/bottom.

A study of plankton dynamics in Wachusett Reservoir has recently been completed (MDC, 2003a) and the following conclusions were drawn:

- Wachusett Reservoir exhibits an annual cycle of phytoplankton succession characteristic of many temperate, oligotrophic systems consisting of the following: minimal activity in winter due to low temperatures and light intensities caused by ice cover, a spring maximum dominated by diatoms, a summer minimum following the spring depletion of nutrients, a secondary peak in the fall, and then a return to low winter densities.



Synura adamsii
(colonial chrysophyte)
Diameter of colony = 95 microns

- Chrysophytes exhibit the most spatial and temporal variability among all phytoplankton taxa; they can peak asynchronously across basin and/or at different depths (generally from the surface to a depth of 8 meters); multiple years of data from Cosgrove Intake suggest that blooms of the problematic taste and odor genus *Synura* are inversely correlated to the relative intensity of the annual spring diatom bloom.
- Current and historical measurements of Secchi transparency are consistent with the seasonal periodicity of phytoplankton described above with greatest clarity documented during summer periods of low densities and periods of reduced transparency corresponding to spring and fall maximums.
- The zooplankton community of Wachusett Reservoir is composed of the typical freshwater fauna of rotifers (Rotatoria) and two groups of microcrustacea; Cladocera (cladocerans or water fleas) and Copepoda (copepods). Rotifers present the most diversity among Wachusett zooplankton and their populations are numerically dominant throughout the year.



Ceratium hirundinella
(dinoflagellate)
Total length = 280 microns



Nephrocytium agardhianum
(colonial chlorophyte)
Colony length = 67 microns

Although Wachusett Reservoir experiences occasional plankton blooms of certain species that cause taste and odor problems, these blooms appear to be part of the reservoir's normal plankton successional pattern. When these plankton blooms occur, they are generally successfully controlled through the use of copper sulfate.

The macrophyte flora of Wachusett Reservoir is composed of approximately twenty species including three species alien or non-native to Massachusetts. The native Claspingleaved Pondweed (*Potamogeton perfoliatus*) is the most widely distributed macrophyte in the reservoir system. The alien species posing the greatest potential threat to water quality is Eurasian Water-milfoil (*Myriophyllum spicatum*) and it has been the focus of intensive control efforts since 2002. Currently, this

alien plant is restricted mostly to Stillwater Basin and Upper Thomas Basin.

Macrophyte beds are mostly located in the sub-basins composing the upper reaches of the reservoir system and in protected coves of the main basin where substrates consist of fine-grained organic substrates; Stillwater Basin supports the greatest diversity of macrophytes found anywhere in the reservoir system.

Macrophytes inhabiting Wachusett Reservoir, including alien and native species, are generally submergent in growth form; exclusively floating-leaved species such as water lilies are absent and emergent species such as sedges and rushes are restricted to the vicinity of stream inlets due to fluctuating water levels in the reservoir.



Tabellaria flocculosa
(chain-forming diatom)
Cell length = 28 microns

3 Overview of BWM Watershed Protection Goals and Programs

This section describes the mandate and the goals of the Bureau of Watershed Management, the agency responsible for protecting the Wachusett Reservoir watershed. The assessment and ranking of potential contamination sources, originally developed in the 1991 Plan, was updated in 1998 and are revised for this 2003 Plan. The revised ranking reflects the water quality goals and emphasizes control of pathogens. In addition, this section presents an overview of the BWM's watershed protection and management programs, which follow from the goals and priorities. Lastly, this section presents the conceptual framework of preservation of forested land and open space, technical assistance to watershed communities to ensure regulations are protecting water resources, and direct action to correct the few existing impacts.

3.1 *Mission*

The Bureau of Watershed Management within the Division of Water Supply Protection of the Department of Conservation and Recreation, a state agency within the Executive Office of Environmental Affairs, has been charged by Chapter 26 of the Acts of 2003, §290 with protection of the Wachusett Reservoir watershed. The Bureau continues a century of MDC management. The MDC Division of Watershed Management was established when Chapter 372 of the Acts of 1984 divided the former MDC Water Division into the DWM, responsible for watershed operation and management, and the new Waterworks Division of the MWRA, responsible for transmission and treatment. BWM is a single-purpose, watershed-focused unit of DCR.

The BWM inherits the mission derived from the MDC Division of Watershed Management's enabling legislation and subsequent amendments, found at MGL c. 92, §§ 104 – 120. The statute directs the BWM to:

...construct, maintain and operate a system of watersheds, reservoirs, water rights and rights in sources of water supply [to] supply thereby a sufficient supply of pure water to the Massachusetts Water Resources Authority, and [to] utilize and conserve said water and other natural resources to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations.

The body of legislation makes directives on specific management aspects of the watersheds, authorizing BWM to:

- Have the exclusive right and control over all ponds, reservoirs, and other property within the watershed system, and [may] order all persons to keep from entering in, upon or over the waters thereof and the lands of the commonwealth or towns surrounding same.
- Make rules and regulations for the protection of the watersheds.

- Establish the Quabbin Watershed Advisory Committee, the Watershed System Advisory Committee (covering Wachusett and Sudbury watersheds), and the Ware River Watershed Advisory Committee.
- Adopt periodic watershed management plans to provide for forestry, water yield, and public access among other purposes.

Beyond its broad mandate, BWM has additional, specific responsibilities as provided in various legislative acts. Some of the acts most currently relevant to BWM are listed in Table 3-1.

Building on the legislative-defined mission, BWM's charge today has evolved:

- To maintain and operate the source facilities (including dams) safely and efficiently.
- To preserve and improve water quality of the supply sources, through regulation, direct action, and cooperation, as needed to protect public health and to meet state and federal water quality standards.
- To fulfill the watershed protection and management requirements associated with drinking water regulations.
- To implement the specific directives of the legislature, such as providing recreation opportunities balanced with the protection of the water supply sources and promulgating and enforcing rules and regulations for BWM lands and for protected zones.
- To involve watershed towns, residents, and the public in appropriate ways in the conduct of the BWM's watershed management functions.

In addition, BWM has defined water quality goals for the system:

- Primary Goals
 - To prevent waterborne disease.
 - To maintain a high quality source water.
 - To meet the source water coliform criterion.
- Secondary Goals
 - To reduce/control nutrient inputs to the reservoir.
 - To reduce risk of a chemical or hazardous material spill.
 - To control general pollutant transport into the reservoir.

Together, the mission and water quality goals provide the basis for all of BWM's activities.

3.2 *Historical Activities*

Since the development of the Wachusett Reservoir in 1908, BWM (and its predecessors, MDC Division of Watershed Management and MDC Water Division) has played a major role in watershed protection and management. Traditionally, the agency's watershed activities have concentrated on managing, operating, and maintaining the water supply system.

Watershed Management. Watershed management activities have included routine water quality monitoring of reservoirs, tributaries, and rivers; environmental quality assessments of subwatersheds; management of the boat fishing areas at Quabbin Reservoir; and oversight of BWM rules for the protection of the water supply (originally enforced by the Metropolitan Police, now by the State Police, Environmental Police, and the Watershed Rangers). BWM has also historically managed its forested lands through such activities as silvicultural operations, planting desired species, and maintaining fire roads. BWM also conducts wildlife management within its water supply lands and waters (e.g., gull control program).

Operations. Operations activities included operating the dams and transfer mechanisms to attain desired reservoir water levels established with consideration to demand, required downstream flow releases, seasonal flooding prevention, and dam safety. MDC also was responsible for operation and maintenance of the Rutland-Holden Trunk Sewer and Relief Trunk Sewer System and coordination among the towns of Rutland, Holden and Worcester; this function is currently performed by MWRA Sewerage Division. BWM is responsible for the construction of the Holden/West Boylston Sewer Extension.

Maintenance. BWM has historically maintained a variety of facilities under its care, such as BWM-owned dams, bridges and buildings, certain Nashua River bridges, the Quabbin Park Cemetery, and BWM-owned land within the watersheds.

BWM and its predecessor agencies have always maintained an active water quality monitoring program for the tributaries and the reservoirs. BWM has historically conducted sanitary surveys and active field inspections to look for pollution sources in the watershed. These surveys are now coordinated through the Environmental Quality Section under a broad structure of Environmental Quality Assessments (EQAs; **see Section 5.3**), which form the foundation for many of BWM's planning and remediation efforts.

MDC and MWRA prepared Watershed Protection Plans (WPPs or Plans) for the Wachusett Reservoir and Quabbin Reservoir/Ware River watersheds. The Plans were completed in 1991 and represented the first comprehensive watershed studies for water supply protection purposes. These Plans were updated in 1998 for Wachusett Reservoir and 2000 for Quabbin Reservoir/Ware River. The Plans follow Department of Environmental Protection (DEP) guidance, and outline a multi-year program of control measures to prevent water quality impacts from activities on and off Commonwealth-owned lands.



Table 3-1
Legislative Acts Relevant to BWM

Source	Summary
Chapter 488 of the Acts of 1895	Creates Metropolitan Water Board, with diverse duties and authorities, including construction of Wachusett Reservoir by taking waters of the Nashua River.
Chapter 168 of the Acts of 1901, § 1,5	Creates Metropolitan Water and Sewage Board.
Chapter 350 of the Acts of 1919, §123	Creates MDC.
Chapter 21 of the Acts of 1931, §1	Grants bird management authority.
Chapter 321 of the Acts of 1927	Authorizes creation of Quabbin Reservoir by taking waters of the Swift River; and diverse related activities.
Chapter 77 of the Acts of 1932	Authorizes removal of game fish from Wachusett for stocking purposes.
Chapter 262 of the Acts of 1932	Authorizes sewer construction.
Chapter 421 of the Acts of 1946	Permits fishing in certain parts of the Quabbin Reservoir (from the shore).
Chapter 300 of the Acts of 1947	Amends c. 421 of the Acts of 1946 to allow adoption of regulations governing fishing and water supply protection.
Chapter 737 of the Acts of 1972 (Kelly-Wetmore)	Sets forth rules for the management of Quabbin and Ware lands.
Chapter 204 of the Acts of 1975	Allows MDC administrative rights of entry like those of DWPC.
Chapter 797 of the Acts of 1979	Requires Payment in Lieu of Taxes (PILOT Payments) to municipalities.
Chapter 372 of the Acts of 1984	Creates DWM (and MWRA), with diverse duties and authority.
Chapter 734 of the Acts of 1985	Adds to the list of organizations from which QWAC membership may be nominated.
Chapter 436 of the Acts of 1990	Amends c. 737 of the Acts of 1972 to allow hunting in accordance with a deer management program.
Chapter 36 of the Acts of 1992 (Watershed Protection Act)	Establishes land use restrictions around water features in Quabbin, Ware and Wachusett; land acquisition authority and related provisions.
Chapter 242 of the Acts of 1995, §§ 2, 3	Creates Ware River Watershed Advisory Committee.
Chapter 26 of the Acts of 2003, §290	Creates Department of Conservation and Recreation, Division of Water Supply Protection.

Source: DCR/DWSP/BWM, 2003.

In the mid-1990s, DWM expanded into a larger role in wastewater management issues in the watershed by working with the towns of Holden and West Boylston to construct sewers, and worked with local Boards of Health to identify major problems and solutions with on-site wastewater disposal systems (see Section 6). Implementing the 1998 Plan over the past five years, BWM programs have addressed public access, wildlife, construction, on-site septic systems, agriculture, spills of hazardous materials, and other issues. From a history of forestry and management of its

own land holdings, the BWM has grown into a steward of the watershed as a whole ecosystem, playing a positive role in managing the uses and activities of water quality significance on both public and private lands.

3.3 *Overview of Watershed Protection Programs*

3.2.1 Current Program

BWM has implemented the 1998 WPP for Wachusett Reservoir Watershed. DEP has determined that the plan complies with its Policy 89-09 and related guidance. DEP has conducted annual on-site inspections of Wachusett Reservoir watershed to evaluate the adequacy of BWM's watershed protection program and has approved the Bureau's watershed program at each inspection.

3.2.2 Assessment of Threats

The 1998 Plan included identification of potential sources of contamination, and ranking of these threats as High, Medium, or Low priority. The 1998 threat priorities were based on the best available information at the time, including DWM knowledge of the land use or activity, federal and state environmental permit records, files from local town boards, land use data, and available maps.

In the five years since the Plan's development, many studies were completed, increasing the available body of watershed and reservoir data (**see Section 8.4**). For the Wachusett Reservoir watershed, BWM and MWRA have completed expanded water quality monitoring (including pathogens, studies of other indicator organisms, and biomonitoring), developed reservoir water quality models, stormwater modeling, various pilot projects such as road Best Management Practices (BMPs), geographic information system (GIS) coverage at a parcel level of detail, wildlife surveys, and EQAs. BWM has also refined specific water quality goals since the 1998 Plan, incorporating them into the Bureau's prioritization of activities.

With BWM's greater knowledge of watershed activities, reservoir hydrodynamics, and water quality, and in the context of defined water quality goals, it is appropriate to revisit the activities and rankings identified in the 1991 and 1998 Plans. While BWM and MWRA remain committed to reducing all potential contaminants in the reservoir, drinking water industry research clearly indicates that control of pathogens must be a top concern. Therefore, activities involving potential exposure to human or animal wastes are high priority for control. Conversely, some types of pollution threats (such as underground fuel storage tanks) are highly regulated by DEP and typically pose a low level risk to surface waters, and are a particularly low threat in the Wachusett Reservoir watershed.

Table 3-2 lists the threats, recommended actions from the 1998 Plan, the status of those actions, current threat status, and staff priorities. The "Staff Priority" column highlights the amount of staff time and resources necessary to address each particular pollution threat. The threat assessment and staff priority, however, may not be equal. For example, stormwater is assessed as a "Medium"

threat, yet it has become a “High” staff priority due to the increased focus on the issue from the national “Phase II” regulations as well as the Bureau’s success on other “High” threat items. **Table 3-3** compares the threat priorities between the 1998 and 2003 Plans; it also points to the Sections that discuss each pollution threat. Most assessments have remained the same. The few modifications that have occurred were made after careful consideration of conditions in the Wachusett Reservoir watershed combined with the status of the watershed protection program.

3.2.3 Framework for Programs

BWM and MWRA are committed to a strong watershed protection program for the Quabbin/Ware/Wachusett water supply system. BWM has adopted a three-tiered approach to watershed protection:

1. Protect the most sensitive areas through ownership or agreements with land owners.
2. Correct existing sources that could cause or have caused contamination of any waters in the system.
3. Work with watershed communities to protect resources while accommodating local needs.

Over time, existing problems will be eliminated and watershed programs will focus on prevention and maintenance. BWM and MWRA believe that this watershed management system provides a drinking water source of exceptionally high quality, and have developed a comprehensive program to ensure that this level of quality will be maintained and enhanced.

Protect Sensitive Areas through Land Ownership and Other Controls

Direct ownership of critical land in the watershed ensures maximum control over land use and provides the best protection of water quality. BWM is one of the largest landowners in Massachusetts; BWM and MWRA are committed to increasing protected land ownership within the watersheds. BWM has implemented an aggressive land acquisition program to add to this acreage since 1991, utilizing a GIS-based acquisition model developed to prioritize remaining undeveloped parcels for purchase based on the greatest benefit to water quality. That model is still relevant and land acquisition priorities continue to be based on its results. Since 1998, 3,414 acres of land have been added to BWM holdings to increase protection. The percentage of BWM controlled land in the Wachusett Reservoir watershed, excluding the reservoir itself, has increased since 1985 from 7.9% to 29.1%. BWM controls 45% of the combined land in the three active water supply watersheds. If ownership of the approximately 4,000 acre Wachusett Reservoir is counted, BWM controls 33% of the watershed.

In addition to the land held by BWM, substantial acreage is protected from development by many other organizations and government agencies that own and maintain land as open space. This includes town conservation land, parcels held by land trusts and other conservation groups, other state agencies (particularly the Division of Fisheries and Wildlife), and other water suppliers (most notably, the City of Worcester). In the case of a state agency with a recreational mission, since 1990 the Bureau has held a Memorandum of Agreement (MOA) with the Department of Environmental Management (DEM, currently the DCR Division of State Parks and Recreation (DSPR)). In the

Table 3-2
1998 Wachusett Reservoir Watershed Protection Plan Proposed Actions and Status

Item	1998 Threat	1998 Actions	Status	2003 Threat	2003 Actions	2003 Staff Priority ¹
Wildlife-Birds	HIGH	Implement bird control measures.	Successfully implemented program.	HIGH	Continue program.	HIGH
Wildlife-Aquatic Mammals	HIGH	Conduct Aquatic Wildlife Control Program.	Successfully implemented program. Increasing requests for assistance from towns and public.	HIGH	Continue program. Augment staff, as resources permit, for outreach and education.	HIGH
Stormwater	MED	Monitor and asses water quality for stormwater impacts.	Ongoing.	MED	Continue; expand as resources allow.	HIGH ²
		Implement institutional and local structural controls.	Ongoing. ³		Continue to review and coordinate local and state highway projects. Assist in implementation of "Phase II" regulations.	
		Construct structural controls on BWM property.	Installed several BMPs, such as filter curtain at Malagasco Brook.		Assess and prioritize possible structural improvements. Construct one stormwater BMP/year.	
		Provide education and outreach.	Ongoing.		Continue program.	
		Coordinate with MHD.	Ongoing.		Continue coordination and expand as resources allow. Utilize regulatory review to implement water quality BMPs.	MED

¹ Staffing priority addresses the amount of staff time and resources necessary to address the pollution threat.

² The Division's stormwater sampling has demonstrated that there is major pollutant input during storm events. Taking into consideration the accomplishments in land acquisition, the sewer project and the Watershed Protection Act administration, stormwater has been promoted to a HIGH staff priority.

³ It is the responsibility of towns and the MHD to construct these controls on local and interstate roads. Recently adopted NPDES Phase II regulations and the state's stormwater permitting process provided new venues for review and coordination.

Item	1998 Threat	1998 Actions	Status	2003 Threat	2003 Actions	2003 Staff Priority ¹
Highways and Railways – Uncontrolled Releases	HIGH (potential)	Construct structural controls to improve safety and provide spill containment.	Installed new guardrails and other minor improvements. Majority of structural controls are responsibility of state or local highway authorities.	HIGH (potential)	Work with towns and MHD through stormwater permitting process and reconstruction projects to achieve structural improvements.	MED
		Map and assess drainage to reservoir and throughout watershed.	Completed mapping of discharges around reservoir.		Complete mapping and assessment of watershed drainage by 2005.	
		Track, manage, and limit transport of hazardous materials through watershed (rail and roadway)	Communication established with railroads. Federal regulations set disclosure standards.		Continue communication as needed.	LOW
		Develop Emergency Response Plan.	Completed.		Update as needed. Coordinate with other security issues.	HIGH
		Coordinate with MEMA.	Completed.		Continue communication as needed.	MED
		Construct watershed signs and stencil drains.	Signs installed through Public Access program.		Replace or install new signs as needed. Potentially provide stenciling through education/outreach programs.	LOW
		Provide Incident Command System (ICS) training to staff and local responders.	Completed.		Update as needed.	MED
		Ensure towns have adequate response equipment. Purchase Reservoir Response Units.	Completed.		Monitor use and update or replace equipment as needed.	MED
		Conduct mock emergency drill with other agencies.	Incomplete.		Conduct drill in 2004. Integrate security concerns into other programs.	HIGH

Item	1998 Threat	1998 Actions	Status	2003 Threat	2003 Actions	2003 Staff Priority ¹
On-site Septic Systems	HIGH/MED once sewers complete	Sewer critical areas. Assess and track on-site system performance and maintenance.	Project will be complete by end of 2004. Work completed on tracking database.	HIGH/MED once sewers complete	Complete Sewer Project. Track connections to sewers. Ensure that problems systems are connected. Monitor water to assess impact of sewers. Assess methods for ongoing tracking of septic systems. Develop methods for homeowner assistance in areas that will not be sewer	HIGH
Erosion	LOW	Identify and monitor construction projects via WSPA. Enforce WSPA, general watershed regulations (350 CMR 11.09), and other environmental regulations.	Ongoing monitoring, communication, and enforcement minimizes impacts from construction.	LOW	Continue to work with landowners to minimize erosion impacts from construction. Enforce all appropriate regulations.	MED ⁴
Local Land Uses – Construction and Future Development	MED	Administer and enforce WSPA, 350 CMR 11.09, and other environmental regulations.	Ongoing.	MED	Continue to administer and enforce regulations.	HIGH
Public Access	MED	Implement and update Public Access Plan. Continue Watershed Ranger program to educate public and enforce regulations.	Completed. Ongoing.	MED	Implement recommendations in Wachusett Access Plan Update. Continue Watershed Ranger Program.	HIGH

⁴ The overall threat to water quality from erosion may not be significant, however the Division has assessed that there can be significant immediate environmental impacts from construction sites that are not properly controlled. This issue is also covered under "Local Land Uses – Construction "

Item	1998 Threat	1998 Actions	Status	2003 Threat	2003 Actions	2003 Staff Priority ¹
Agriculture-Chemicals	MED	Install BMPs.	Half of recommended BMPs installed; remainder are in process.	LOW ⁵	Survey through EQAs and routine water quality sampling.	LOW
		Provide outreach and education on water quality issues.	Coordinated efforts with DFA.		Continue coordination with DFA.	
Agriculture - Livestock & Crops	HIGH	Work with farmers to implement BMPs. Monitor and assess agricultural impacts through EQAs.	Half of recommended BMPs installed; remainder are in process.	LOW ⁵	Complete BMP installation. Re-assess volume of agricultural impacts.	LOW
Gasoline/Petroleum Storage	LOW	Identify problems via EQAs. Monitor releases through legal ads, field observation and coordination with DEP.	Ongoing.	LOW	Continue monitoring through all available processes.	LOW
Highways & Railways-Road Salting	LOW	Monitor through standard water quality testing and EQAs.	Ongoing.	LOW	Continue to monitor through standard water quality testing and EQAs.	LOW
Highways & Railways - Herbicide Use	MED	Work through MEPA and DFA to enforce exiting regulations.	Ongoing review of Right-of-Way Yearly Operating Plans. Participated in regulatory review.	LOW	Continue review of annual herbicide application plans and participation in regulatory review.	LOW
Local Land Uses - Gravel Mining	LOW	Monitor through WsPA and EQAs.	Ongoing.	LOW	Continue to monitor through WsPA and EQAs.	LOW
Permitted Activities - Solid Waste Facilities	LOW	None.	There are no active solid waste facilities in the Wachusett Reservoir watershed.	LOW	Maintain communication with DEP.	LOW

⁵ Agriculture - Chemicals was assigned a MEDIUM threat risk and Agriculture - Livestock & Crops was assigned a HIGH threat risk in the 1998 Plan due to concerns regarding several unknowns, such as farm activity and the nature of pathogen transmissions. Based on evaluations done over the past five years, including water quality sampling and analysis, environmental quality assessments, and studies by the University of Massachusetts, MDC has re-assigned these risks to LOW.

Item	1998 Threat	1998 Actions	Status	2003 Threat	2003 Actions	2003 Staff Priority ¹
Permitted Act - NPDES/ Groundwater Discharges	LOW	Monitor and identify via EQAs.	Track through EQAs. All NPDES permits in the watershed are minor discharges.	LOW	Continue to monitor through EQAs. See stormwater recommendations above	LOW
Permitted Activities - Hazardous Waste Generators	LOW	Monitor and identify via EQAs.	Ongoing.	LOW	Continue to monitor through EQAs.	LOW
		Support Household Hazardous Waste Collection Days.	Funded set-up costs for regional collections.		Provide support if requested.	LOW
Private Forestry	LOW	Ensure private forestry complies with state regulations. Promote Ch. 61 protection.	Ongoing.	LOW	Continue to encourage private landowners to responsibly manage their forest resources.	LOW
Unauthorized Activities	LOW	Utilize Watershed Ranger Program and staff surveillance to enforce watershed regulations.	Ongoing.	LOW	Continue Watershed Ranger Program and maintain cooperative relationship with state and local police.	MED
Uncontrolled Releases - Fixed Site	LOW	Coordinate with DEP.	Track through EQA and staff surveillance.	LOW	Continue to resolve projects through DEP processes.	LOW

Comprehensive Measures					
Item	1998 Actions	Status	2003 Actions	2003 Staff Priority	
Land Acquisition and Management	Continue Land Acquisition Program.	5 % increase in BWM controlled land (both fee and Conservation Restrictions), to a total of 29% of watershed.	Continue to purchase priority parcels as resources permit.	MED	
	Develop Wachusett Reservoir Watershed Land Management Plan.	Completed.	Implement Land Management Plan recommendations	HIGH	
Watershed Protection Act	Administer WsPA.	Ongoing.	Continue administration of the Act.	HIGH	
BWM Enforcement Powers	Continue to identify violations of BWM and other environmental regulations.	Ongoing.	Continue surveillance and enforcement activities.	HIGH	
Water Quality Monitoring	Continue routine water quality sampling.	Ongoing.	Continue program and increase stormwater monitoring and data analysis	HIGH	
Local Bylaws and Regulations	Meet with local boards and provide technical assistance. Fund and administer Technical Assistance Contract Program.	Provided services at meetings and during business hours. Developed TA contract program.	Provide assistance within available resources.	LOW	
MEPA Oversight	Review projects submitted to MEPA.	Ongoing.	Few projects require MEPA review. WsPA and other regulations provide opportunity to review most major construction projects in the watershed.	LOW	
DEP Involvement	Coordinate with DEP.	Ongoing.	Maintain ongoing communication and coordination with DEP.	MED	

Comprehensive Measures				
Item	1998 Actions	Status	2003 Actions	2003 Staff Priority
Public Education	Provide school programs, interpretive programs, and Resource Center. Watershed Rangers have daily contact with visitors.	Ongoing. Interpretive Center established at Stillwater Farm.	Maintain educational and interpretive programs. Watershed Rangers continue education through daily contact with visitors.	MED
Environmental Quality Assessments (EQAs)	Provide comprehensive assessments of water quality on a subbasin level.	Replaced sanitary surveys with more comprehensive EQAs.	Follow five-year cycle of EQA development. Promote recommendations identified by EQA process for implementation in watershed management activities.	HIGH

Table 3-3
Comparison of Threat Priorities, 1998 – 2003

POTENTIAL SOURCE OF CONTAMINATION	1998 THREAT	2003 THREAT	PLAN SECTION(S)
Wildlife – Birds	High	High	4.3.2
Wildlife – Aquatic Mammals	High	High	4.3.2
Stormwater	Medium	Medium	6.2
Highways and Railways – Uncontrolled Releases	High (Potential)	High (Potential)	6.3
On-site septic systems (Once sewers complete)	High (Medium)	High (Medium)	6.1.2
Erosion	Low	Medium	6.4.1
Local Land Uses – Construction	Medium	Medium	5.2, 5.3, 6.4.1
Local Land Uses – Future Development	Medium	Medium	4.1, 5.2, 5.3, 6.1, 6.2, 6.4.1
Public Access	Medium	Medium	4.3.1
Agriculture – Chemicals	Medium	Low ¹	6.4.2
Agriculture – Livestock & Crops	High	Low ¹	6.4.2
Gas/Petroleum Storage	Low	Low	5.2, 5.3
Highways and Railways – Road Salting	Low	Low	6.2, 6.3
Highways and Railways – Herbicide Use	Medium	Low ²	6.2, 6.3
Local Land Uses – Gravel Mining	Low	Low	5.2.1, 5.3
Permitted Activities – Solid Waste Facilities	Low	Low	5.2.2, 5.3
Permitted Activities – NPDES/Groundwater Dischargers	Low	Low	5.2, 5.3
Permitted Activities – Hazardous Waste Generators	Low	Low	5.2, 5.3
Private Forestry	Low	Low	6.4.3
Unauthorized Activities	Low	Low	4.3.1
Uncontrolled releases – Fixed Site	Low	Low	5.2.2, 5.3, 6.3.2

Source: DCR/DWSP/BWM, 2003

¹ Based on evaluations done over the past five years, including water quality sampling and analysis, environmental quality assessments, studies by the University of Massachusetts, and the reduction in the number of active farms, MDC has re-assigned these risks to LOW.

² Reduction of threat based upon pending adoption of revisions to 333 CMR 11.00.

MOA, BWM and DSPR agree to coordinate the management of adjacent lands under their respective care and control in order to enhance the protection of water resources. The total BWM-owned and other protected lands in the Quabbin, Ware, and Wachusett Reservoir watersheds exceed 63% of the watershed area.

Correct Existing Problems

When the 1991 Plan was written, the watershed assessment revealed some serious threats to source water quality. Although the watershed has only a limited number of point sources (e.g., direct discharges from wastewater treatment plants or industrial sites), there were nonpoint sources of pollution. Remediation measures focusing on these areas were developed and implemented; the 1998 Plan continued this strategy. BWM developed and maintains the highly successful gull harassment program and wildlife management strategy, both of which greatly reduced the coliform levels at the Wachusett intake.

DWM also worked with the communities of Holden and West Boylston to identify solutions to localized, severe septic system problems through the Wastewater Facilities Plan. The sewer project is 80% complete; when finished, approximately 40% of the homes in the Wachusett Reservoir watershed will be sewered to the Upper Blackstone Water Pollution Control Facility (discharged outside the watershed). These actions have resulted in, and will continue to produce, water quality improvements in the reservoir and tributaries.

BWM staff identify, evaluate, and monitor any environmental violations and sources of potential pollution in the watershed, utilizing tools such as water quality monitoring, site inspections, and permit reviews. BWM works with private landowners, town governments, transportation entities, and various state agencies to achieve compliance with environmental regulations and to reduce pollution potential in the watershed.

Work with Watershed Communities to Ensure Protection for the Future

Since BWM and MWRA must maintain good working relationships with watershed communities to protect water quality, they developed a protection strategy that supplements the direct ownership of the most sensitive lands by working with communities and individual landowners to ensure that development does not degrade water quality.

Staff enforce the 1992 WsPA, ensuring a buffer area between future development and watercourses and prohibiting land uses of concern within protective zones. A total of 12,305 acres in the Wachusett Reservoir watershed are regulated by the Act. There is an ongoing program of technical assistance and outreach for watershed town boards, which oversee many land use regulations. BWM also developed a program to work with owners of forested tracts of land to develop professional forest management plans to protect water quality. BWM and DEP work closely together and have procedures to ensure compliance of key environmental regulations such as Title 5, Stormwater Management Policy, NPDES permitting, the Wetlands Protection Act, and MEPA Regulations. Many of these regulations were revised in the 1990s, significantly strengthening control over both existing and future land uses and activities.

Plan Outline

The remainder of this Watershed Protection Plan establishes the framework for meeting the Bureau's mission. These chapters are organized as follows: Section 4 presents BWM's Land Acquisition Program and other land protection activities; Section 5 presents a summary of current monitoring programs; Section 6 addresses non-point source issues; Section 7 gives background on BWM infrastructure; Section 8 summarizes the comprehensive support programs provided by the Bureau; and Section 9 outlines a specific implementation strategy.



4 Resource Protection

Protecting natural resources – both land and water ecosystems– is a crucial element to watershed management. BWM has successfully developed and implemented three significant plans that minimize impacts to water quality. *The Land Acquisition Plan*, originally written in 1991 and revised in 1998, sets the goals for the Bureau's land purchases. *The Wachusett Reservoir Watershed Public Access Plan*, a 1996 document updated in 2003, details policies for public use of BWM property in the watershed. *The Wachusett Reservoir Land Management Plan*, published in 2001, describes how the BWM manages the natural resources on its watershed land. Wildlife control, in particular the harassment of gulls and other water-based birds, is a critical element to the Bureau's success at maintaining the water quality parameters necessary for an unfiltered drinking water supply. BWM also relies on other owners of conservation land, both public and private, to help meet its water quality goals.

4.1 Land Acquisition Program

Accomplishments:

- Acquired sensitive, high-risk lands. BWM currently owns or controls through agreement 29.1% of the Wachusett Reservoir Watershed.
- Acquired and conducted an annual monitoring program on 30 Conservation Restrictions (CR), totaling 2,003 acres.

Assessment:

BWM acquired 3,415 acres over the past five years bringing the total acreage now held both in fee and CR to 18,438 acres. The total amount of land under BWM control is 20,602 acres after the inclusion of the property held by DCR/DSPR that is under a Care and Control Agreement with the Bureau. Each land acquisition goal has been reached or is ahead of schedule, including 25% ownership target established by EPA and internal benchmarks established by the 1998 MDC Land Acquisition Plan.

Key Actions:

- Maximize long-term water quality benefit by acquiring and protecting sensitive watershed lands.
- Implement and update the GIS land acquisition model.
- Pursue negotiations for obtaining watershed parcels, as identified through the GIS model, either in fee or conservation restrictions.
- Seek to obtain additional CRs on other protected lands by including specific water supply protection language.
- Coordinate acquisitions with other public and private entities to maximize land protection in the watershed.

Background

Over the past fifteen years, BWM has conducted a watershed land acquisition program “to protect sensitive watershed land from urbanization and to restore and maintain stable forest cover on this

land.” The chief value of this program is to help maintain high water quality into the future. The pollutants that are potentially associated with urbanization include: bacteria, pathogens, nutrients, sediments, heavy metals, and other contaminants associated with increased stormwater runoff.

A major tenet of watershed management is protection through ownership of interests in watershed lands. Owning and managing watershed lands surrounding a water supply source is recognized as the most direct and proven method of protecting the water source’s long-term quality for many reasons, including:

- A forested watershed provides the best quality water.
- The purchase of undeveloped lands protects water sources from development, preventing vegetation removal, drainage alteration, and the increase of impervious areas that move pollutants quickly towards streams.
- The purchase of vegetated buffers provides natural “treatment” or protection to lessen water quality impacts of future development.
- The purchase of problem properties effectively halts the problem of activity or use, and ensures proper clean-up or revegetation of the site.

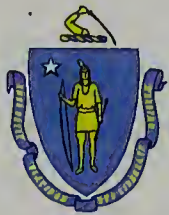
The modern-day Land Acquisition Program was initiated with \$3 million from the 1983 Open Space Bond. The 1987 Open Space Bond established an additional \$30 million account to purchase property within the Watershed System. The Watershed Protection Act authorized a \$135 million bond, to spent at a rate of \$8 million per year. \$100 million was spent prior to the remaining \$35 million being integrated into the 2002 Environmental Bond.

Current Program and Accomplishments

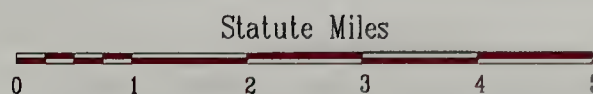
BWM purchases land both in fee and conservation restrictions (CRs), which are typically conveyed as “friendly,” or consensual, eminent domain takings. Since 1998, 3,415 acres have been acquired by fee or CR bringing the total acreage that the BWM manages to 18,389 acres (**see Table 4-1**). At present, BWM has acquired 30 CRs, totaling 2,003 acres, and will continue to pursue CRs when feasible. Based on the 1991 and 1998 *MDC Land Acquisition Plans*, the BWM is on or ahead of schedule of protecting sensitive watershed lands with the Wachusett Reservoir watershed (**see Figure 4-1**).

Since the Land Acquisition Program began in 1985, BWM has increased the percentage of agency controlled land at the Wachusett Reservoir watershed from 7.9 to 29.1 percent, which also includes land protection agreements with other state agencies (**see Table 4-2**).

BWM developed a comprehensive computer model to guide these acquisitions in the Wachusett Reservoir watershed. This model scores the sensitivity (watershed index) of all land using twelve weighted criteria and three basin overlay multipliers. These criteria include: proximity to the reservoir, development threats that could endanger water quality, protection of rare and endangered plant species habitat, land near tributaries, wetlands and aquifers, wildlife habitats, scenic amenities and land adjacent to other BWM holdings. The watershed index, calculated by the computer model, indicates areas that are rich in water resources and sensitive to degradation. The Bureau now controls 36% of the most sensitive lands in the watershed according to this watershed index (**see Table 4-3**).



Protected Open Space Wachusett Reservoir Watershed



Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management

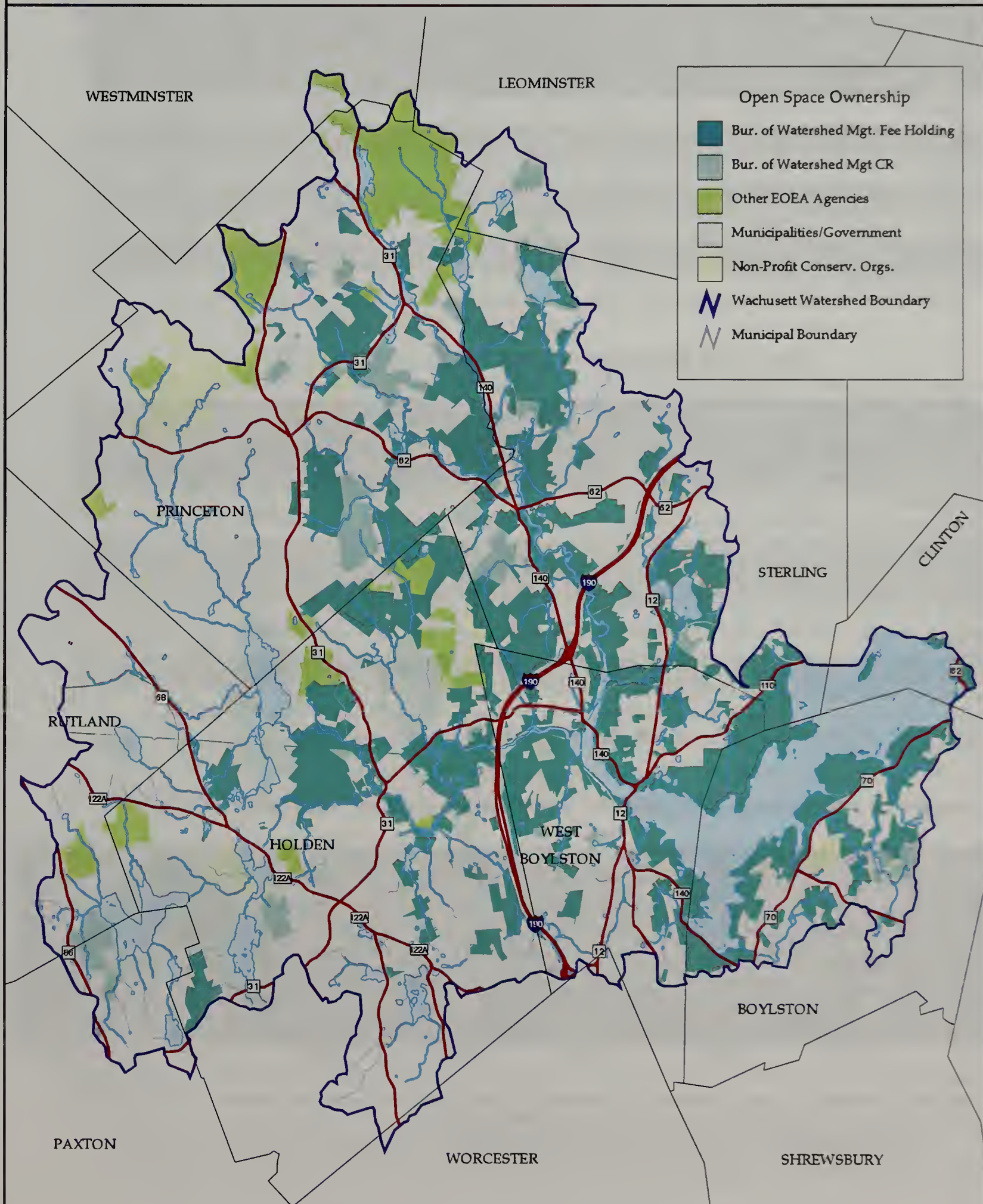


Figure: 4-1

Table 4-1
BWM Land Acquisitions 1999 – 2003

Fiscal Year	Watershed			Total Acres	Total Cost (millions)
	Wachusett Reservoir	Quabbin Reservoir	Ware River		
1999	888	0	0	888	\$7.8.
2000	873	0	0	873	\$6.8
2001	733	0	224	957	\$6.6
2002	685	107	632	1426	\$7.7
2003	235	11	0	246	\$2.25.
Total	3,414	118	856	4,388	\$31.15

Source: DCR General Counsel. 2003

Table 4-2
Watershed Management Land Holdings, 1985 – 2003

Watershed	1985		1998		2003	
	Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Wachusett Reservoir	5,608	7.9%	18,074 ¹	25.5%	20,600 ²	29.1%
Quabbin Reservoir	51,792	54.5%	54,203	57%	54,321	57.2%
Ware River	19,300	31.3%	22,838	37.0%	23,694	38.2%
Total	76,700	33.7%	95,115	41.8%	98,615	43.3%

Source: DCR General Counsel and DWSP GIS. 2003

¹ Includes 2,213 acres owned by DCR Division of State Parks and Recreation under a Care & Control MOU and FY99 acquisitions.

² Includes 2,213 acres owned by DCR Division of State Parks and Recreation under a Care & Control MOU.

Table 4-3
Comparison of Protected Land and Wachusett Reservoir watershed Index of Sensitivity¹

% of Watershed BWM Controlled¹	% of Watershed Other Permanent Open Space	% of Watershed Chapter 61	Total % Protected Open Space	% of High Sensitive Land BWM Controlled²	% of High Sensitive Land Other Permanent Open Space	% of High Sensitive Land Chapter 61	Total % of High Sensitive Land Protected
29%	14%	10%	53%	36%	9%	7%	54%

Source: DWSP GIS. 2003

¹ The Watershed Index of Sensitivity is a computer generated index of areas rich in water resources and sensitive to degradation. This table demonstrates that the lands directly controlled by the BWM are the most critical to water quality protection.

² Includes 2,213 acres owned by DCR Division of State Parks under a Care & Control MOU.

Assessment

Significant achievements in land acquisition have been attained by the Bureau over the past ten years. Many of the near-term goals for BWM control of lands, both internal and external, have been met. Future land acquisition efforts will continue where needed to protect highly sensitive land from development.

The Environmental Bond of 2002 allocated \$16 million dollars for watershed land acquisition. This amount represents a significant drop in funds compared to prior budgets over the past ten years. The Bureau must reassess its priorities based on this decrease. The associated management responsibilities of fee owned land – control of public access, policing encroachments, forest maintenance – is another factor that the Bureau realizes must be considered during the land acquisition process (see **Section 4.2.3**). Developing partnerships with non-profits, municipalities, and other agencies for the purpose of protecting land will help keep costs down, as will, when appropriate, the purchase of CRs (see **Section 4.3**).

The currently allocated land acquisition funds, and any future funding mechanisms, will continue to be distributed for purchases among the three active water supply watersheds. The Wachusett Reservoir watershed, because it is the closest reservoir to consumers that also has the largest percentage of sensitive watershed land, remains the highest priority. The second priority for land acquisitions will be the remaining stream frontage that drains directly into the Quabbin Reservoir. Third priority will be the Ware River watershed and hydrologically remote sections of the Quabbin Reservoir watershed.

The *1998 MDC/DWM Land Acquisition Plan* was intended to cover a ten year time frame. Changes in budgets and administration, however, have created new parameters that were not factored into that plan's goals. The Land Acquisition Plan should be re-assessed to determine if the current priorities best reflect the next five years' potential funding and an even longer term perspective.

There were several buildings amongst the many land purchases made by the Bureau over the past five years. These structures require remediation and/or removal. The Bureau needs to continue its efforts to environmentally restore all of its newly acquired properties.

Control Approach

Goal

- To provide long-term water quality protection through the acquisition of rights to sensitive watershed lands, allowing the establishment of stable forest cover and reduction of potential development.

Objectives

- Meet the land ownership goals established by the Bureau's Land Acquisition Plan.
- Continue to acquire, by fee or Conservation Restriction, highly sensitive watershed land.

- Optimize land acquisition funds through cooperative agreements with state and federal agencies, local communities, and non-profit organizations.
- Increase the purchases of Conservation Restrictions.

Action Items

- Evaluate 1998 Land Acquisition Plan and assess whether it needs modification.
- Acquire control, through both in-fee acquisition and Conservation Restrictions, of highly rated land based on computer modeling and staff expertise.
- Work with EOEA and the Commonwealth Office of Development to partner with other conservation oriented entities to protect land in the Wachusett Reservoir watershed.
- Complete demolition, remediation and restoration of all property requiring such work.

4.2 *Control of BWM lands*

4.2.1 Public Access

Accomplishments:

- Updated the Wachusett Reservoir Watershed Public Access Plan.
- Continued Ranger program to patrol watershed, educate visitors and schools, and intervene when there are public access regulation violations.
- Coordinated with State, Environmental and Local Police to enforce BWM public access regulations.
- Installed easy-to-read signs throughout watershed.
- Developed material to aid public knowledge of rules for distribution through Rangers, at kiosks, and on the Bureau's web page.
- Created pilot hunting and bicycling programs, which were made permanent in 2003.

Assessment:

BWM has an established effective and comprehensive program of control over recreational and unauthorized use of its facilities. This program is based on no-access protective zones around water supply intakes, the presence of an active ranger force, and the control of permitted activities. This restrictive public access policy is aimed at preventing the introduction of microbiological pathogens and monitoring security.

Key Actions:

- Continue full implementation of the Wachusett Public Access Plan.
- Continue with the Ranger program to improve voluntary compliance with the public access regulations through public education.
- Continue enforcement of public access regulations through partnership with the State Police, Environmental Police and local police departments.
- Improve key public access entry points in the watershed with signs, interpretive kiosks, appropriate parking facilities and gates.
- Ensure the security of the drinking water supply.

Background

Public access, in the Bureau's management context, is a wide-ranging concept. It includes:

- The physical ability to enter and use land for recreational activities.
- The legal restrictions or prohibitions related to access or specific land or water-based recreational activities.
- Sign placement.
- Mapping.
- User education.
- Intergovernmental coordination.
- Public safety.
- Protection of public and private property rights.

BWM controls access to its lands and waters through state regulations, 350 CMR 11.00, which provide general conditions for water supply protection. This law gives the BWM sole jurisdiction over its lands and the authority to close parts of the watershed system to public access, when deemed necessary, to protect land and water resources from degradation.

The potential for impacts to the drinking water supply and other environmental resources were carefully weighed before considering any uses on BWM properties. In general, any human use will cause some level of impact. BWM determines what uses may be allowed in which areas in order to limit potential water quality impacts to acceptable levels. Because the Bureau purchases and maintains its lands for water supply protection, it must err on the side of caution in identifying uses that compromise water supply protection. BWM considers:

- Type and intensity of proposed public access use.
- The physical features of the area being considered for public activities.
- The potential for impacts to water quality from the entire spectrum of visitors.
- The resource needs to properly manage any particular use on its properties, always mindful of the primary mission of the Bureau – water supply protection.

The criteria to determine whether an activity is compatible with the Bureau's water supply mission identifies whether the activity has the potential to degrade the quality of water in the watershed or to degrade any natural resource within the watershed. BWM considers the following information in making such a determination:

- Bureau of Watershed Management goals, and guiding legislation and regulations.
- Environmental impacts to water quality and land resources.
- Potential for impacts to watershed resources and waterworks infrastructure.
- Potential impacts to staffing and other resources.
- The safety of users, abutters, staff, and general public safety.

The 1996 *Wachusett Watershed MDC Public Access Plan* (the 1996 Plan) was the first written Public Access Plan for the Wachusett Reservoir watershed. The goal of this plan was to reduce the existing level of threats to water quality from public use of BWM watershed lands and to provide management programs that afford long term protection of Wachusett Reservoir.

While BWM realizes that most of the visiting public complies with its rules and regulations, it was determined that new policies were needed to provide greater control over the minority of users who disregard or abuse the privilege of access to BWM lands. In addition, it was clear that some allowed activities needed to be limited or curtailed.

Management recommendations in the 1996 Plan focused on surveillance, education, and enforcement to impose greater control over unauthorized activities. The *Wachusett Reservoir Watershed Public Access Plan Update* was produced in 2003 in order to identify changes in existing conditions, identify and evaluate the policies that have been implemented, and assess additional needs to meet the mandate of water quality and resource protection.

Current Program and Accomplishments

Implementation of the recommendations in the 1996 Plan has resulted in better protection from impacts of public access. Identifying distinct Management Zones provided a successful structure for managing public access. In particular, establishing the Intake Protection Zone restricted immediate access to the most critical areas of the water system. Other measures promoted by the 1996 Plan that were successfully implemented include:

- Creating the uniformed Watershed Ranger program into an effective and consistent official presence to visitors. The Watershed Rangers ensure that BWM regulations are followed, and they have also evolved into an important element for handling emerging security concerns.
- Significantly improving communication and cooperation with state and local police, resulting in better prevention and protection.
- Installing portable toilets at three locations.
- Placing improved signs at key points on BWM properties throughout the watershed.
- Increasing education and outreach efforts.

Watershed Rangers

Implementation of the Public Access Plan integrates numerous staff resources to achieve the objectives of the plan. The Wachusett Watershed Rangers continued to proactively patrol the Wachusett Reservoir watershed area to educate the public about BWM rules. The Rangers teach the public to practice good stewardship habits and comply with existing rules and regulations. An average of 15,000 visitor contacts are logged every year (see **Table 4-4**).

The Watershed Rangers deal with violations of BWM Rules and Regulations according to the severity of the infraction. Minor violations usually result in the Rangers' attempts at immediate education about the water supply and by explaining BWM's rules to the violator. If the person is a repeat violator, or for serious infractions, the Massachusetts State Police (MSP) are involved. Oftentimes, violations lead to follow-up activity. In the case of horse, ATV, and similar violations, Rangers may investigate to find where the party enters the BWM land and visit the owners to discuss the rules and water supply protection.

Rangers, as well as all Bureau staff, monitor the watershed as part of normal operations and report potentially damaging activities, erosion control concerns, and illegal dumping to the BWM Environmental Quality staff for investigation and any necessary remedial action (see **Section 5.3**).

The State and Environmental Police are involved with the Rangers at those times when more extensive efforts are necessary to limit the illegal use of certain properties. The MSP based at the Holden barracks, the primary law enforcement agency in the watershed, have taken a very proactive

role in protecting the watershed and its drinking water supply. In addition to their regular 24 hour patrolling, the MSP have coordinated and undertaken a concerted effort to curtail illegal ATV operations on state and railroad property. The MSP vigorously pursue criminal violations of BWM rules and regulations.

The events of September 11, 2001 have heightened concerns regarding security and the need to protect public works from possible terrorist action. The Watershed Rangers played a lead role in closing the North and South Dikes as well as the Dam to the public immediately after September 11. Since that time, the Rangers have focused their attention on security around the main reservoir basin, utilizing foot, motor vehicle and boat patrols (see Section 7.3 for more details on security issues).

Table 4-4
Wachusett Watershed Rangers
Average Visitor Contacts and Prohibited Activity Notices
1999-2002

Type of Contact	1999	2000	2001	2002
Visitor Contacts	13768	17455	14669	14457
Activity or Violation				
Maintenance	347	219	79	27
Dogs	213	208	139	128
Fishing	113	161	140	25
Trespass (P)	117	66	81	184 ¹
Trespass (S)	86	30	49	19
Swimming (P)	150	48	78	71
Swimming (S)	89	24	47	33
Alcohol	22	13	6	0
Snowmobiles	6	5	18	1
Bikes	144	92	66	48
Wading	150	95	124	120
Horses	9	4	1	2
Sliding	112	26	5	0
Gates	N/A	37	20	14
Other	25	22	11	4

Source: DCR Watershed Rangers. 1999 - 2002

Key:

Maintenance includes re-erecting signs, posts, markers and removing debris.

Trespass (P) involves trespass in the Primary Protection Zone.

Trespass (S) involves trespass outside the primary zone or illegal night access.

Swimming (P) involves swimming in Class A waters.

Swimming (S) involves swimming in other waters.

Sliding includes illegal snow sliding or sliding on the grass hill beside the Dam.

Other includes commercial signs, bird feeding, walking on ice, fires, and use of metal detectors.

¹ Increase due to heightened security following September 11, 2001.

Public Access Policies

The policy recommendations made in the 2003 *Wachusett Reservoir Watershed Public Access Plan Update* did not significantly alter the restrictions or allowed uses initially defined in the 1996 Plan (see **Table 4-5**). The delineation of management zones remains a useful tool to define and describe allowed uses (see **Figure 4-2**). The Access Plan Update expanded the Intake Protection Zone to include the former Off-Watershed Zone so that it now encompasses the entire area around Wachusett Dam and Cosgrove Intake (see **Figure 4-3**). **Table 4-6** is a summary of all public access policies by management zone.

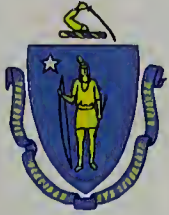
Table 4-5
Changes In BWM Public Access Policy
in the Wachusett Reservoir Watershed 1996 vs. 2003

ACTIVITY	1996 POLICY	2003 Policy
Shoreline Fishing	Allowed seasonally in the Reservoir & Tributary Shoreline Zone; year round fishing allowed in Tributary Headwaters (with waders) and Off-Watershed Zones.	Integrate Off-Watershed Zone into Intake Protection Zone; no fishing allowed in Intake Protection Zone.
Hiking	Allowed in all areas except the Intake Protection Zone.	Expand to allow access to lands east of Gates 1 and 2 (Management Area A2) ¹ .
Cross-Country Skiing	Allowed in all areas except the Intake Protection Zone.	Expand to Allow access to lands east of Gates 1 and 2 (Management Area A2) ¹ .
Boating	Non-motorized boats allowed on Quinapoxet and Stillwater Rivers in the Tributary Headwaters Zone; non-motorized boats allowed on West Waushacum Pond.	No Change
Swimming	PROHIBITED	No Change
Bicycling	Pilot program allowed off-road bicycles, with MDC permit, in two areas within the Tributary Headwaters Zone.	No permit requirement for off-road biking in designated area; clarify policy to allow biking from Gate 39 to 42 (formerly Off-Watershed Zone).
Horseback Riding	PROHIBITED	No Change
Camping	PROHIBITED	No Change
Motorized Vehicles (ATVs, ORVs, Snowmobiles)	PROHIBITED	No Change
Hunting	Pilot program allowed hunting, with MDC permit, in specified areas within the Tributary Headwaters Zone.	Hunting allowed with BWM permit. Hunting area is entire Tributary Headwaters Zone (locations must still meet DWFELE regulations).
Dog Walking	Allowed below Wachusett Dam with leash or while hunting in Tributary Headwaters Zone.	No Change ²

Source: Wachusett Reservoir Watershed Public Access Plan Update, 2003.

¹ See Figure 4-3 for location of Gates and Management Areas.

² All access below the Wachusett Dam is temporarily restricted until completion of construction activities.



Public Access Management Zones Wachusett Reservoir Watershed



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Div. of Water Supply Protection
Bureau of Watershed Management

Statute Miles

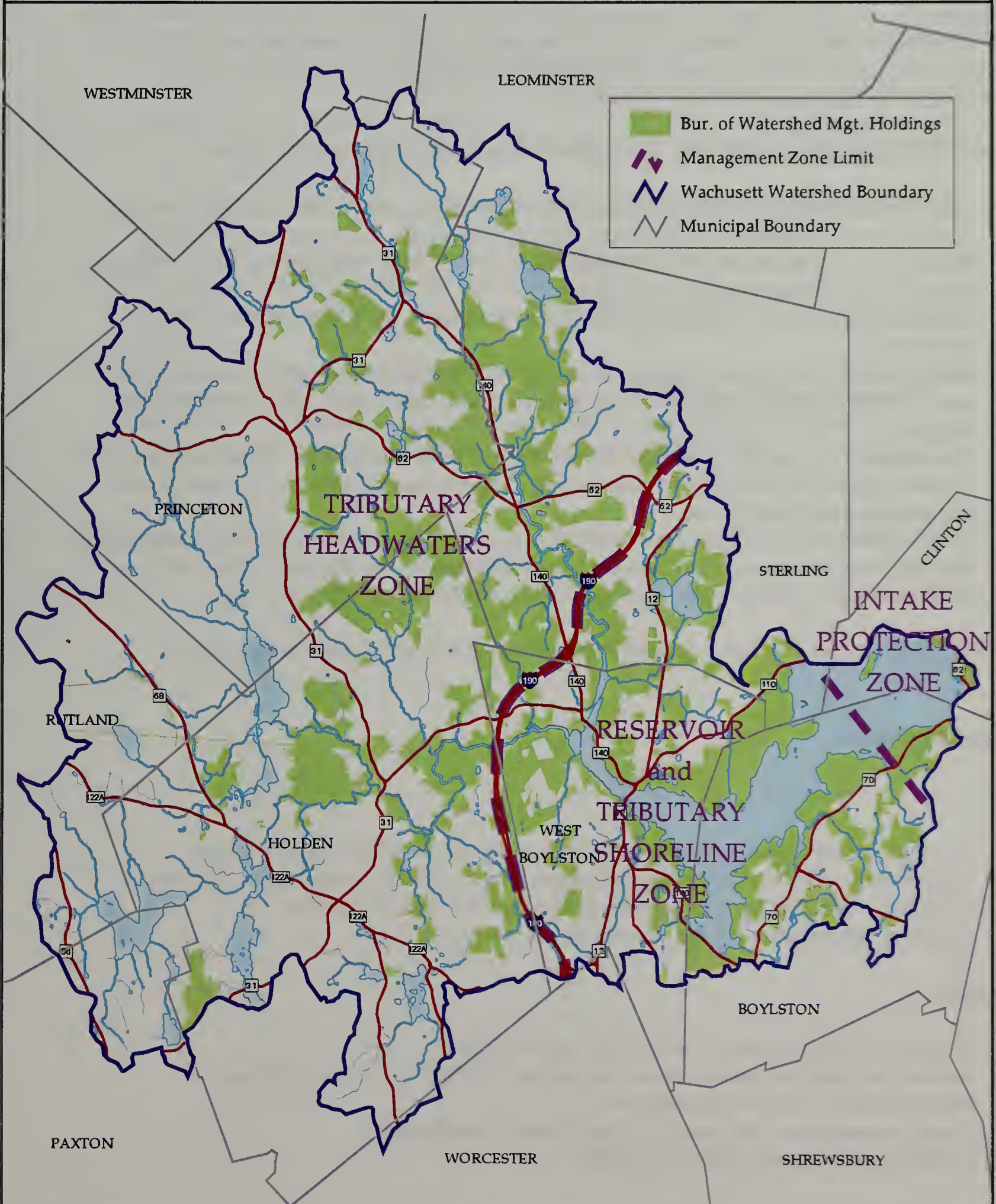


Figure: 4-2

Assessment

BWM has an established comprehensive and effective program of control over recreational and unauthorized use of its facilities. This program is based on no-access protective zones around water supply intakes, the presence of an active ranger force, and the control of permitted activities. This restrictive public access policy is specifically aimed at preventing the introduction of microbiological pathogens and for security reasons.

The areas of general concern identified in the 2003 Public Access Plan Update include:

- **Structural and Access Controls:** Gates and other barriers need to be continually assessed. Parking problems continue along roads, especially at popular gates and sites.
- **Signs:** There are some areas where signs, despite BWM improvements, are still confusing or other indirect communication problems persist.
- **Maps:** Improved maps would better guide public access to the designated areas of the watershed.
- **Enforcement:** Dog walking, horseback riding, ATV use and snowmobiling continues to occur on BWM lands, despite extensive education and surveillance efforts of Watershed Rangers.
- **Sanitation:** The location of portable toilets needs to be re-evaluated, different/additional sites considered, and the feasibility of constructing more permanent facilities evaluated. Trash dumping remains problematic.
- **Encroachments:** The increase in BWM property has made monitoring for encroachments by abutters an on-going need (this concern is also addressed in the *Wachusett Reservoir Watershed Land Management Plan: 2001-2010*; see **Section 4.2.3**).

The 2003 Public Access Plan has a detailed implementation strategy to address these issues.

Control Approach

Goals

- To minimize the threat to water quality from public use of BWM watershed lands.
- To gain community understanding and support for the BWM's public access policies.
- To attain compliance with and enforce BWM Public Access regulations.
- To assess, and revise if needed, current access policies.

Objectives

- Protect watershed resources from public access impacts.
- Assure that public access is safe and appropriate to BWM's water quality goals.
- Inform the public on access restrictions.
- Ensure, as necessary, the security of the drinking water supply.
- Evaluate public access impacts as needed.

Action Items

- Continue Watershed Ranger program to improve voluntary compliance with the public access regulations through public education.
- Continue enforcement of public access regulations through partnership with the State Police, Environmental Police and local police departments.
- Improve key public access entry points in the watershed with signs, interpretive kiosks, appropriate parking facilities and gates.
- Develop and distribute Public Access Map(s) that show locations for hiking, bicycling, hunting, fishing, and parking.
- Provide public education and interpretive services through direct contact and printed materials.
- Foster partnerships with local entities to develop and maintain facilities on BWM land in keeping with BWM policies and regulations.
- Maintain a regular monitoring program for BWM forest roads, access points and reservoir shorelines.
- Implement Access Plan recommendations.
- Provide a yearly review of the Wachusett Reservoir Watershed Access Plan and, if necessary, a public meeting to gather input on implementation of the plan.
- Update the Wachusett Reservoir Watershed Access Plan in 2008.

Table 4-6
BWM Public Access Policy Summary
Wachusett Reservoir Watershed

ACTIVITY	Intake Protection Zone					Reservoir & Tributary Shorelines; West Waushacum Pond Zone	Tributary Headwaters Zone
	A1	A2	B1*	B2*	C		
VEHICLE ACCESS							
Off Road Driving (ORVs, ATVs)	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Snowmobiling	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Bicycling	⊘	⊘	⊘	⊘	⊘	⊘	✓
FOOT ACCESS							
Walking/Hiking	⊘	✓	✓	✓	✓	✓	✓
Dog Walking	⊘	⊘	⊘	✓	⊘	⊘	⊘ ¹
Cross-Country Skiing	⊘	✓	⊘	✓	✓	✓	✓
Shoreline Fishing	⊘	⊘	⊘	⊘	⊘	✓	✓
Fishing with Waders	⊘	⊘	⊘	⊘	⊘	⊘	✓
Horseback Riding	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Hunting	⊘	⊘	⊘	⊘	⊘	⊘	✓ ²
WATER ACCESS							
Boating – non-motorized	⊘	⊘	⊘	⊘	⊘	✓ ³	✓
Boating – motorized (including “jet skis”)	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Swimming	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Ice Skating/Ice Fishing	⊘	⊘	⊘	⊘	⊘	⊘	⊘
OTHER ACTIVITIES							
Camping	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Picnicking	⊘	⊘	⊘	⊘	⊘	✓	✓
Fires & Cooking	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Programs/Assemblies	⊘	⊘	⊘	⊘	⊘	✓ ²	⊘
Trail Clearing/Trail Marking/Advertising	⊘	⊘	⊘	⊘	⊘	⊘	⊘
Collecting/Metal Detecting	⊘	⊘	⊘	⊘	⊘	⊘	⊘

✓ – Public access is allowed in designated areas only

⊘ – Activity prohibited

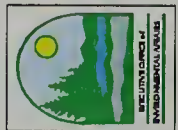
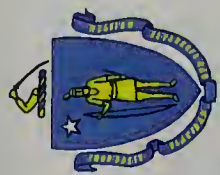
* All access to this area is currently prohibited for security reasons. BWM will re-open this area for the allowed uses when conditions permit.

¹ Dogs allowed with hunting permit

² BWM Special Permit required

³ Canoes/Kayaks allowed only at West Waushacum Pond

Public access is allowed in designated areas only. Any activity which injures or defaces the property of the Commonwealth is strictly prohibited. All alcoholic beverages are prohibited. Night access is prohibited on BWM land in the Wachusett Reservoir watershed. See 350 CMR 11.09(2) for complete list of regulations. For additional information, contact the Wachusett/Sudbury Watershed Ranger Station at (978) 365-3800 or go to www.state.ma.us/mdc/pacc.htm. In an emergency, contact the Watershed Rangers or the Massachusetts State Police at (508) 829-8410.



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Bureau of Watershed Management

INTAKE PROTECTION ZONE

- Area A1
- Area A2
- Area B1 - Promenade Area
- Area B2
- Area C
- MDC Property outside the Intake Protection Zone
- Limit of Intake Protection Zone
- MDC Fireroads
- MDC Gates



Figure: 4-3

4.2.2 Wildlife Control

Accomplishments:

- Continued to implement the Bird Harassment Program which maintains the reduced fecal coliform bacteria counts at the intake.
- Managed the Aquatic Wildlife Pathogen Control Zone, in which animals of concern (beaver and muskrat) are surveyed and removed from this critical area.
- Implemented habitat modifications to reduce nesting and visiting geese and to discourage beaver habitation.

Assessment:

The Bird Harassment Program and other wildlife controls are key pieces to the Bureau's success at maintaining low fecal coliform bacteria counts in the Wachusett Reservoir. The period from February 1999 to December 2003 has been the longest stretch of time since the promulgation of the Surface Water Treatment Rule in 1989 that there have been no exceedances of the SWTR's Fecal Coliform Bacteria criteria at Wachusett Reservoir (**see Figure 2-5**). The impact of birds on the intake water quality continues to be significantly diminished due to the harassment program and related efforts. Aquatic mammals are a potential concern, but are being controlled in critical areas; there is no evidence of pathogen contamination from these animals reaching the intake.

Key Actions:

- Continue successful Bird Harassment Program, including ongoing research on all available and appropriate methods.
- Implement additional habitat modifications where appropriate.
- Continue beaver and muskrat controls in the Aquatic Wildlife Pathogen Control Zone and initiate control in rest of reservoir; annually evaluate the effectiveness of these controls.

Background

Gulls, geese, ducks, and cormorants have historically roosted in large numbers at the northern part of the Wachusett Reservoir near the Cosgrove Intake from early fall until ice covers the reservoir and again in spring after ice-out. These birds like this particular area because other water bodies in the area freeze first and they feel safe in the wide open water. DWM began an intensive gull and goose harassment program at Wachusett Reservoir during 1992 to try to reduce reservoir fecal coliform bacteria levels attributed to the large roosting bird population. The basic premise of the Bird Harassment Program is to move the birds away from the intake area to distant parts of the reservoir or to other water bodies entirely.

Over the first few years of the program, DWM experimented with a variety of harassment equipment. DWM formed a Bird Harassment Committee, obtaining involvement of the state ornithologist, USDA personnel, and consultants. The Bird Harassment Committee was helpful in identifying new possibilities, particularly in approaching nesting populations and the need for some exterminations. DWM also addressed implementation needs, including designating and training staff and determining the times when the harassment efforts were needed. DWM monitored water quality and took bird counts daily during this period, and gathered data on when gulls arrived at the reservoir (season and time of day), and the direction they came.

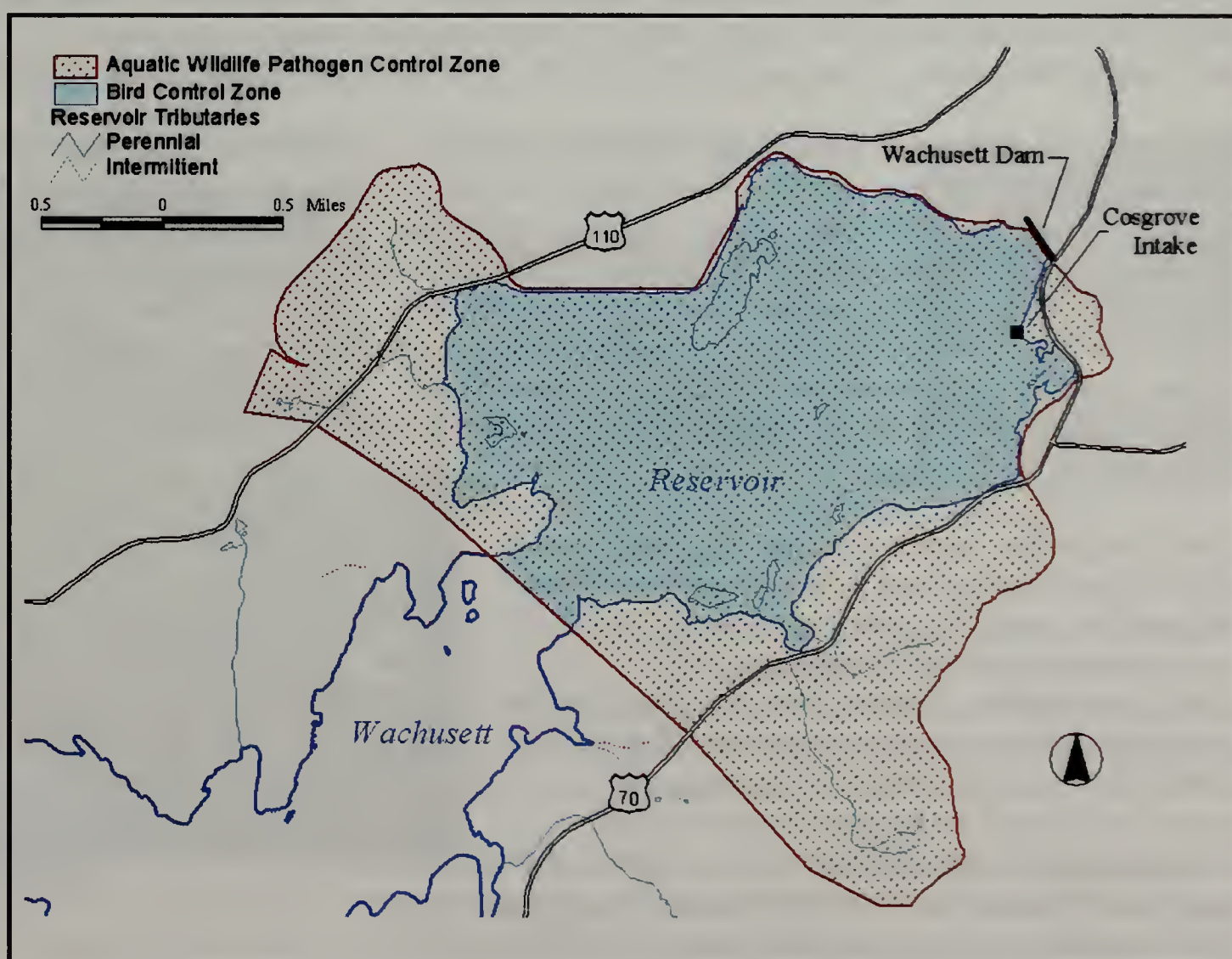
Wildlife programs and projects focused on species other than birds have grown tremendously since the 1995 stationing of a professional wildlife biologist in the Wachusett Reservoir watershed. Key wildlife populations, such as muskrat and beaver, are managed to mitigate adverse impacts on water quality, infrastructure and other watershed resources.

Current Program and Accomplishments

BWM defined the Bird Control Zone (see **Figure 4-4**), consisting of the reservoir area north of the narrows (a constricted area at the approximate east-west midpoint of the reservoir). Data confirm that by moving gulls out of the north end (either to leave the reservoir or relocate at an alternative roost area approximately 4.5 miles from the intake), fecal coliform bacteria levels drop to normal minimal levels.

The Bird Harassment Program utilizes daily human presence in boats and on shore using a variety of pyrotechnics (e.g., 12-gauge and .22 caliber shell crackers and screamers). During the winter months the Wachusett Reservoir is monitored by two observers from 3 P.M. until dark on five to seven days per week and by a single observer periodically during the day on Monday through Friday. Harassment from shore or from a boat is used as needed to move birds away from the north end of the reservoir.

Figure 4-4: Bird and Wildlife Pathogen Control Zones



A variety of techniques have been used to aid in harassment, including propane canons, “scary eyes,” netting of rocks, destruction of eggs, and gull distress calls (see **Figure 4-5**). A laser rifle was tested in 2003 to help supplement shoreline harassment activities, but had only limited success. Simple pyrotechnics remain the most effective tool for moving birds away from the north end of the reservoir.

Land management practices were modified to help discourage geese from feeding on the North Dike near the reservoir. A conversion of mowed fields to uncut grassland and tree plantations took place and the numbers of geese on the shore of the reservoir dropped significantly.

The program includes a nightly count of birds landing at the north end of the reservoir and those bypassing the area, a weekly comprehensive bird count at the roost area to the south, a minimum of two available boats, hovercrafts during icing conditions, and lethal methods to reinforce non-lethal tactics. BWM maintains daily logs of activity, and prepares bi-weekly and annual reports of the program documenting its effectiveness. The program remains flexible and can be modified rapidly to add observers, harassment activities, and time periods monitored when necessary.

The Bureau initiated a few additions to advance the Bird Harassment Program. A permanent boat dock facility was constructed in 1999 by the Bureau’s Civil Engineers in the Carville Basin near Cosgrove Intake. This new facility improved both personnel safety and the ability for staff to easily launch boats throughout the year. The Bureau originally purchased two small Hovercraft to reach birds in the water with partial ice cover. Their effectiveness, however, was limited in severe weather conditions due to their size. A larger Hovercraft was purchased in 1999, allowing staff to be on the Reservoir in difficult weather and for longer periods of time, thus improving the program’s consistency and effectiveness.

The Aquatic Wildlife Pathogen Control Zone (see **Figure 4-4**) was established in 1999, providing a framework for the Bureau to control beaver and muskrat year-round. Beaver can dramatically alter habitats, which in turn can affect other wildlife species and humans. In addition, beaver can cause localized damage to roads, culverts, and trees, although the wetland habitat they create is seen as beneficial to a variety of wildlife species. Beaver have been linked to water-borne pathogens and are potential carriers of both *Giardia* and *Cryptosporidium* (MDC, 1999c). Whether any one colony is seen as beneficial or detrimental depends on the resources affected. The Bureau has also identified muskrat as key species in its pathogen prevention program due to their ability to potentially cause damage to watershed infrastructure (i.e., dikes and dams).

Bureau policy regarding beaver problems takes into account the variety of situations that may arise and applies solutions as needed to offer the best long-term remediation. In situations where muskrat are causing damage to infrastructure, appropriate measures are used to mitigate the damage, including lethal removal of the individuals followed by habitat manipulation to discourage reoccupation. A detailed description of these control program can be found in the 1999 *Quabbin and Wachusett Reservoirs Watersheds Aquatic Wildlife Pathogen Control Zones* and the *Wachusett Reservoir Land Management Plan: 2001 – 2010*.



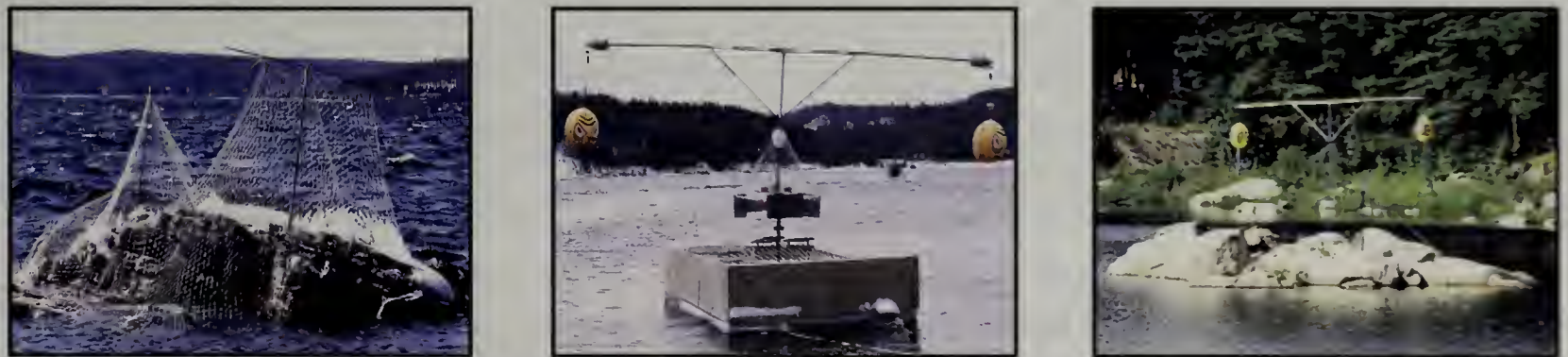
Beaver lodge.

Assessment

BWM's Bird Harassment Program has been extremely effective and has directly reduced coliform levels at the intake. Fecal coliform bacteria samples are collected four to seven times per week at the Cosgrove Intake to monitor the effectiveness of the program; samples rarely contain more than ten fecal coliform bacteria colony forming units per 100 mL (cfu/100 mL) and often contain no bacteria at all. The Wachusett Reservoir intake fecal coliform bacteria levels have been in compliance with the SWTR criterion for a filtration waiver since the program's initiation in 1993, except for one reporting period in 1999 (see **Figure 2-4**). This one period of exceedance was caused by a lack of appropriate foul-weather equipment, which was subsequently purchased and integrated into the program.

Years of harassment appear to have finally modified bird behavior. Although gull numbers on or near the reservoir are generally as high as or higher than previous years, the number of birds actually settling at the north end is now very low and harassment from shore sufficient to move them towards the preferred south roost or off-reservoir. In 2002 the maximum number of gulls observed on the north end shallows was less than fifty through the month of November, and boat-based harassment was not needed until November 25th, more than two months later than in previous years. A total of 500 to 1,300 gulls were observed passing over the north end each night, but none were allowed to remain. The number of gulls utilizing the south roost during the past five years ranged from 1,000 to 6,000. Numbers remain significant, but are lower than historical highs, presumably due to a reduction in local landfills.

Figure 4-5: Fixed Deterrents Used in the Bird Control Program



Fixed deterrents used in the Bird Control Program. Netting, at left, discourages perching. The floating (middle) and land based (right) installations scare birds with motion and prerecorded distress calls. (MDC, 2002d)

Beaver populations within the Wachusett Reservoir watershed continue to expand, as beaver mortality rates remain low. As beaver continue to colonize riparian areas, it is important to recognize their role in hydrologic and ecological processes. There is some evidence to suggest that beaver ponds, like most wetlands, have a filtering effect that improves water quality by decreasing erosion and trapping sediments, particulates, and nutrients.

The Pathogen Protection Zone demarcates where beaver and muskrat will be eliminated and excluded on a continual basis for water quality protection in the Wachusett Reservoir. Situations outside the protection zone in which water quality is being threatened will be handled on a case-by-

case basis. In some instances, colonies located on DCR property may not affect DCR's structures or resources but impact adjacent private property. It is necessary to evaluate these situations on a case-by-case basis to determine DCR's level of involvement in mitigating damage occurring on non-DCR property.

Reduction of bird numbers within the Bird Control Zone at the north end of the reservoir should be sufficient to reduce impacts from fecal coliform bacteria at the intake. Control of beavers and muskrat within the Pathogen Control Zone will also protect water quality and infrastructure. Observation, harassment, and removal activities should be utilized year round and modified as necessary to provide adequate protection for the metropolitan Boston drinking water supply.

Control Approach

Goals

- To prevent elevated fecal coliform bacteria and other pathogen levels at the Cosgrove intake through appropriate wildlife controls.

Objectives

- Prevent birds from utilizing the north end of the reservoir as a roosting area.
- Continue to monitor and document bird activity to help understand behavior.
- Continue to use appropriate land management practices to discourage geese feeding on the North Dike and other critical areas.
- Continue to control resident Canada goose populations to restrict population growth.
- Continue to remove beaver and muskrat from the Control Zone and discourage their occupation.

Action Items

- Continue Bird Harassment Program using all available and appropriate methods.
- Continue to implement habitat modifications where appropriate.
- Continue beaver and muskrat control in the Aquatic Wildlife Pathogen Control Zone and, when feasible, initiate control in rest of reservoir; routinely evaluate the effectiveness of these controls.
- Monitor wildlife populations for presence of protozoa.
- Respond to complaints on beaver and beaver impoundments on DCR property impacting private land; provide assistance as time allows.
- Continue to locate all geese nesting on the reservoir and treat eggs to prevent hatching.

4.2.3 Land Management

Accomplishments:

- Professional forest staff planned and managed forests to improve long-term water quality protection.
- Conducted active silviculture on Quabbin, Ware, and Wachusett Reservoir watersheds, effectively maintaining healthy and diverse forests.
- Followed stricter BMPs than the Massachusetts Forest Cutting Practices Act in BWM's silviculture practices.
- Completed the 10 year Wachusett Land Management Plan in 2001.
- Successfully completed audit "Green Certification" for BWM forests by the Scientific Certification Systems, a Forest Stewardship Council accredited company specializing in reviewing forest management practices.
- Performed an intensive survey in 1999 to identify all non-forested habitats on BWM land at Wachusett.

Assessment:

The majority of the Wachusett Reservoir watershed forest is over 70 years old. It originates from plantation establishment during the first half of the century and from natural regrowth. The 16,384 acres of BWM-owned forests and fields provide a significant level of long-term water quality protection to Wachusett Reservoir. The successful Land Acquisition program has provided BWM with many new parcels, all of which require assessment, analysis, and management. While the vast majority of BWM-owned land is forested, a small percentage will be maintained in an open state. This management decision recognizes the value of fields, lawn and shoreline areas.

Key Actions:

- Continue to conduct silviculture activities on BWM land with the goal of forest diversity. Continue inspections to ensure compliance with BWM BMP requirements for water quality protection.
- Continue to follow the objectives outlined in the Wachusett 10-year Land Management Plan, including approaches for newly acquired lands, management of fields and shoreline, and forestry.

Background

Professional forestry staff have been working since 1979 on BWM lands in the Wachusett Reservoir watershed. Two foresters were specifically assigned in 1988 to the watershed. BWM's forest land in the Wachusett Reservoir watershed has been managed primarily by creating small openings in the forest to stimulate growth and diversify the species and age classes for maintaining a healthy and vigorous forest for watershed protection. Wachusett foresters not only adhere to the state's BMPs specified by the Massachusetts Forest Cutting Practices Act, but also incorporate stricter Conservation Management Practices (CMP) guidelines to eliminate water quality threats associated with silviculture. Careful monitoring is undertaken and, to date, no water quality degradation has been associated with BWM silvicultural practices.

Current Program and Accomplishments

The ten year Wachusett Land Management Plan was completed in 2001. The plan addresses a variety of topics including land acquisition and protection, forestry, wildlife, cultural resources, biodiversity and open space management. A major component of these topics is the maintenance of a forest cover on the majority of BWM's watershed holdings, in order to maximize the natural filtering capability of these lands.

Land Protection

A major tenet of watershed management is protection through ownership and control of watershed lands. Owning and managing undeveloped lands (particularly forested land) surrounding a water supply source is recognized as the most direct and proven method of protecting the source's long-term quality.

Payments In-Lieu of Taxes (PILOT)

After land is acquired for watershed protection, the BWM is required by MGL c. 59, s.5G to make Payments In-Lieu of Taxes (PILOT) on these properties. This law took effect for Wachusett Reservoir watershed lands in 1987. The PILOT amount is calculated by multiplying the local commercial tax rate by the land valuation as determined by the Department of Revenue (DOR). While the program is administered by the BWM, the PILOT funds come from the MWRA. The DOR is required to value the land at its "highest and best" use; this means that property that is under Article 97 open space protection is still valued as developable parcels. A key provision of this statute is that the PILOT amount can never be less than the previous year's amount, even if the tax rate or valuation diminishes. In FY2003, a total of \$4,965,870 was distributed to 31 communities that have water supply property. Approximately \$2 million, or 40% of this total, went to seven municipalities in the Wachusett Reservoir watershed (see **Table 4-7**).

Revaluation of state property occurs, by law, only once every five years. Unfortunately for the communities, this means that any property acquired within this cycle will not be included in determining PILOT amounts. However, BWM does pay the remainder of the existing year's taxes at the time of acquisition, and if the sale occurs in the second half of the fiscal year, it is obligated to pay the following year's taxes as well. Furthermore, if a property is being purchased out of Chapter 61 or 61A (the Forestland Taxation program), the agency is required to pay "rollback" taxes to the town, rebating the previous four years' tax abatements.

The PILOT program provides a significant benefit to the watershed system communities. They receive the same revenue from permanently protected open space that they would have received from developed land, without the associated municipal costs of police, school and fire services. BWM will continue to implement the PILOT statute, work with the MWRA to ensure proper payments, and assist the DOR in its revaluation efforts.

Table 4-7
Wachusett Reservoir Watershed Payments in Lieu of Taxes (PILOT)

Community	Property Valuation FY 2000	PILOT FY2000	2000 DOR Property Revaluation	PILOT 2001	% PILOT Increase	PILOT FY2003	% Total FY2003 PILOT
Boylston	\$16,104,737	\$302,903	\$23,690,400	\$471,439	56%	\$500,000	10%
Clinton	\$3,174,235	\$107,765	\$3,950,100	\$124,349	15%	\$124,902	3%
Holden	\$12,562,313	\$229,639	\$22,334,100	\$372,979	62%	\$372,979	8%
Leominster	N/A	N/A	\$466,900	\$7,148	N/A	\$7,148	.1%
Princeton	\$1,912,312	\$31,438	\$9,127,300	\$149,414	375%	\$149,414	3%
Sterling	\$8,599,452	\$138,623	\$18,164,800	\$260,302	88%	\$260,302	5%
West Boylston	\$14,104,101	\$253,874	\$29,566,800	\$569,752	124%	\$569,752	11%
TOTAL	\$56,457,150	\$1,064,243	\$107,300,400	\$1,955,384	84%	\$1,984,498	40%

Source: DCR/DWSP/BWM Planning, 2003

Land Disposition

The Bureau of Watershed Management must contend with ongoing pressure from both private and municipal parties for disposition of lands for purposes inconsistent with water supply protection. While some BWM parcels may not be deemed of critical importance to water supply protection, these areas require careful and consistent scrutiny prior to disposition. The BWM will consider land disposition only under exceptional circumstances.

The BWM Land Disposition Policy provides a framework for the agency to properly discharge its obligations to protect the water supply and to protect the Commonwealth's broader interests in open space protection under Article 97 of the Constitution of the Commonwealth. The intent of the Watershed Land Disposition Policy is to provide additional watershed-specific instructions to the Executive Office of Environmental Affairs on disposition of Article 97 lands.

Boundaries and Encroachments

It is important to sustain the marking of boundaries because of the fragmented pattern of BWM owned land in the Wachusett Reservoir watershed. The primary purpose of marking property boundaries is the avoidance of encroachment. Once an encroachment has been identified following field investigation, the Bureau will send a letter or letters to the offender to address the issue. Most resolutions end cordially and rarely has court action been required.

Forest Management

The primary goal of management of the Wachusett Reservoir watershed forest is the creation of a forest that best supports the production of high quality drinking water from the land. This watershed protection forest is vigorous, diverse in species and ages, actively accumulating biomass, and actively regenerating.

The first forest management plan for any BWM property, written in 1960 for the Quabbin Reservoir watershed forest, proposed that a predominantly uneven-aged forest provides the best protection for a high quality water supply. Every Quabbin plan since then has agreed with this statement including the latest 1995 – 2004 plan. The first Wachusett Plan continued this tradition with a conviction based on the most up-to-date information, the latest review of relevant information and literature, and the experience of the professional staff in the management of the Wachusett forest.

The conversion of the present even-aged forest to a forest comprised of at least three age classes has already begun, although at a slower pace than is now required, given the significant increase in acreage resulting from the land acquisition program. When the forestry program began in 1979, the BWM owned approximately 5,600 acres in the watershed compared to the 16,822 acres owned as of the writing of this plan. The creation of three well-defined age classes in any section of the forest necessitates that one-third of the forest be regenerated to a new age class followed by the creation of another age class some appropriate length



An uneven aged forest.

of time later. This length of time will be about 20 to 30 years, a sufficient span of time to allow the various age classes to grow and thereby be well differentiated from each other. The principal goal for the next 30 years will be the establishment of a new age class on approximately one-third of the 12,000 acres of manageable forest on BWM land in the Wachusett Reservoir watershed

The silvicultural system that will be employed throughout the vast majority of the Wachusett forest in order to create three distinct age classes, is a variation of an uneven-aged system. The silvicultural method that perhaps best describes the regeneration plan for the Wachusett forest is group-selection or uneven-aged with patch cutting as suggested by Marquis (1991).

Over the next 30 years, one-third, or 4,000 acres, of the managed forest at Wachusett will be converted to a new age-class. For this age class to be evenly distributed throughout BWM land and evenly spaced through time, 130 acres must be regenerated each year. Therefore, approximately 400 acres will be treated annually (one-third of which is regenerated).

Green Certification

The BWM, in cooperation with EOEA and other state agencies, entered into a contract in 2002 to “Green Certify” all of BWM managed forests. Scientific Certification Systems (SCS), an independent organization, reviewed the agency’s forest management practices on all BWM watersheds in 2002. This third party audit reviewed and critiqued the BWM’s forest management practices with the ultimate goal of certifying BWM forests. Previous to this contract the MDC had accredited the Quabbin Reservoir watershed in 1997, making it the first public forest land accredited in North America. SCS has submitted their preliminary report which recommends certification for all BWM forests. This not only demonstrates the BWM’s commitment to sound land management, but also provides the public consumer with an identified product that has been procured in a socially and environmentally responsible way.

Management of Non-Forested BWM Lands

In 1999, forestry and wildlife staff performed an intensive survey of all non-forested, non-wetland habitats on BWM land in the Wachusett Reservoir watershed. The following data were collected or calculated for each area:

- Habitat type (Forb dominated, Grass dominated, Shrub dominated, Hay field, Gravel pit, Administrative)
- Primary Cover (Forb, Grass, Shrub)
- Secondary Cover (Forb, Grass, Shrub)
- Primary Soil Class (Xeric, Mesic, Hydric)
- Secondary Soil Class (same)
- Slope (<1%, 1-5%, 6-10%, >10%)
- Aspect
- Invasives Present (Yes/No, including a list of species)
- Sub-Basin
- Acres
- General Comments (including the presence of birds that require non-forested habitats).

There are currently 162 uniquely identifiable non-forested management areas totaling 964 acres on BWM lands in the Wachusett Reservoir watershed (an additional 5 areas totaling 39.6 acres exist on off-watershed BWM lands). This represents about 6% of the total 16,384 acres of BWM land in the watershed. A management plan will be written for each field the Bureau intends to maintain as a field, which will address: the specific goal(s) of management, cutting/mowing schedules and procedures; control of invasive plants; filter strips width; and other maintenance practices.

The Bureau has been actively managing much of the shoreline around the Wachusett Reservoir. The shoreline is cut on a rotational basis and only tree species are removed. The goal is to encourage the herbaceous and shrub species to dominate the shoreline. This helps to limit leaf litter in the reservoir as well as protects the arborvitae along the shoreline from too much shading. Cutting woody vegetation along the shoreline will also help to discourage beavers from occupying these areas.

Management of New Acquisitions

As a result of the land acquisition program, DCR has many newly acquired parcels. For each new acquisition, bureau staff perform an initial assessment of the property, which includes the identification of any hazardous waste issues, evaluation of forest stands, and decisions regarding demolition or maintenance of any structures on the parcel.

Management of Biodiversity

The Bureau's goals for biodiversity focus on either maintaining or enhancing natural ecosystems across the watershed. The Bureau recognizes that its greatest contribution to regional biodiversity is protecting large areas of land from development and maintaining most of those lands in forest cover.



Vernal Pool.

Assessment

The majority of the Wachusett forest is over 70 years old, and originates from plantation establishment during the first half of the century and from natural regrowth. The 16,435 acres of BWM-owned forests and fields provide a significant level of long-term water quality protection to Wachusett Reservoir.

The successful Land Acquisition program has provided BWM with many new parcels, all of which require assessment, analysis, and management. This increase in land, however, has also limited the ability of existing staff to address the volume of routine maintenance on all Bureau property. Additional staff will help rectify this situation. In the meantime, a process has been initiated to ensure that land management work is prioritized based on water quality, emergency access and security issues.

Although most BWM-owned land in the Wachusett Reservoir watershed is forested, the number of non-forested BWM properties has also increased; there is an ongoing need for coordinated management of these fields, lawn and shoreline areas. The *2001-2010 MDC/DWM Wachusett Reservoir Watershed Land Management Plan* describes bureau staff activities on DCR lands in greater detail.

Control Approach

Goals

- To follow the land management guidelines that are outlined in the Wachusett Reservoir Watershed Land Management Plan.
- To continue to conduct all silvicultural activities and other management strategies with the ultimate goal of water quality protection.
- To assess all newly purchased lands and plan accordingly in order to manage them in the best way possible.

Objectives

- Create a vigorous, multi species, multi-layered forest that best supports the production of high quality drinking water from the land.
- Continue to enhance and maintain the ability of the watershed forest to both resist and recover from disturbance.
- Assess and implement immediate management needs on all newly acquired lands. Keep forest assessment updated following new acquisitions.
- Ensure through the use of strict CMPs that the maintenance of non-forested habitat has no negative impact on water quality.

Action Items

- Continue to conduct silviculture activities with the goal of forest diversity.
- Continue inspections to ensure compliance with BWM CMP forestry requirements for water quality protection.
- Continue to cut the reservoir shoreline on a rotational basis in order to encourage herbaceous and shrub species to dominate the shoreline.
- Write management plans for each parcel that the Bureau intends to maintain as a field.
- Identify and provide habitat for rare flora and fauna in order to promote biodiversity and eliminate, and prevent where possible, the spread of non-native invasive species.
- Continue to follow the objectives outlined in the Wachusett 10-year Land Management Plan, including approaches for newly acquired lands, forestry and management of fields and shoreline.
- Inspect BWM property bounds to identify encroachments.
- Conduct outreach with abutters of BWM lands to inform them of BWM property bounds and allowable uses of BWM lands.

4.3 Other Protected Lands

Accomplishments:

- Identified, characterized, and positively affected the protected lands owned by other parties, including the type of forest management and public access allowed on these lands.

Assessment:

In addition to the 20,600 acres owned or controlled through agreement by BWM, 9,590 acres are in protective ownership by EOEA agencies, towns, and private non-profit agencies. The Chapter 61 tax abatement program also provides a limited degree of protection to the 7,042 acres of enrolled privately owned lands.

Key Actions:

- Maintain inventory of protected lands.
- Continue the Conservation Restriction monitoring program.

Background

There are various protected open space lands within the Wachusett Reservoir watershed that are not managed by the BWM but still provide water quality protection. The owners of these properties include other state agencies, municipalities, nonprofit conservation organizations and private citizens.

Conservation Restrictions (CRs) on a private owner's property are an increasingly important form of land protection. CRs constitute a partial acquisition of rights to land ownership, usually in the form of development restrictions. The entity that purchases a CR agrees to acquire limited rights to property and to record these rights as an attachment to a landowner's deed. The landowner remains the owner and retains all rights to ownership except those described in the easement. This

agreement costs less than fee acquisition. CRs acquired by the Bureau for watershed protection must help insure the maintenance of a pure public water supply. It is the policy of the Bureau to expend funds for the purchase of conservation easements only on acreage with both present and projected uses that do not conflict with this water protection goal. Continued use of the CR property by its owners for forestry, wildlife, recreation, and privacy purposes is encouraged. Conservation easements do not require owners to make their land accessible to the public, but the Bureau annually monitors all CRs to inspect for continued compliance.

Another protection strategy for private land is the Chapter 61 program, which reduces property taxes for qualified forestry, agricultural and recreation lands. The Chapter 61 program protects against residential or commercial development. These lands are significant as a control on urbanization, but they may admit, under Chapter 61A, agricultural activities that can be a potential water quality concern (see **Section 6.4.2**). These lands, however, are not permanently protected; property can be removed from the program if the owner reimburses a town for the tax reductions plus a penalty surcharge. If a piece of Chapter 61 land is placed on the market for development, municipalities and the state have the first options to purchase the property. If no conservation minded buyer can be identified, then the owner has the right to build as otherwise allowed by local and state regulations.

Accomplishments:

All Conservation Restrictions that the Bureau now holds are field checked each year to maintain compliance. In 2002, the MDC and the city of Worcester successfully negotiated a conservation restriction agreement and MOU on approximately 2,800 acres of Worcester's water supply landholdings within the Wachusett Reservoir watershed. Legislation is being created to officially transfer the Conservation Restriction to the BWM.

Assessment

In addition to the 20,600 acres owned or controlled through agreement by BWM, 9,590 acres are in protective ownership by EOEA agencies, towns, private non-profits, and private landowners in the Chapter 61 program (see **Table 4-8**).

The Bureau's approach to maximize its land acquisition funds by purchasing Conservation Restrictions has made it a leading holder of these easements in the Commonwealth. While not providing as complete control as fee purchases, CRs are a significant resource protection strategy. The Bureau monitors each CR on an annual basis and works with the landowners to resolve any compliance issues with the language of the easement. The 2,003 acres held in CR are included in the figures of "BWM Controlled Land" presented in Section 2 and 4.1.

Approximately 7,000 acres are enrolled in the Chapter 61 program, which continues to be an integral element in the state's land conservation program. These enrolled properties, however, require continual observation because they can relatively easily be converted into residential or commercial uses. Towns, and then the BWM, have a "first right of refusal" to acquire a Chapter 61 property when it is placed on the market. Unfortunately, the time period for making this real estate transaction is usually much too short for either a municipality or the state to identify and commit the

necessary funds. Therefore, the BWM encourages owners who are considering the sale of their property to provide enough lead time for the agency to pursue, if warranted, an acquisition.

Table 4-8
Non-BWM Protected Lands in the Wachusett Reservoir Watershed

Agency	Acres	% of Watershed
DSPR ¹	2,213	3.2%
Other EOEAs Agencies	1,926	2.7%
Municipalities	5,375	7.6%
Other Government/Nonprofit Organizations	2,289	3.2%
Total Permanent Protected Open Space	11,803	16.7%
Chapter 61	7,042	10%
TOTAL Other Protected Lands	18,846	26.7%

Source: DWSP GIS, 2003

¹ These lands are under a Care & Control MOU between DSPR and BWM. This figure is included in Section 2 and 4.1 as part of the acreage under BWM control.

Control Approach

Goals

- To maximize the water quality protection provided by non-BWM conservation land.
- To establish the Bureau's CR program as a model for other agencies programs.

Objectives

- Perform baseline surveys soon after a CR has been purchased.
- Monitor all CRs on a yearly basis and resolve any compliance issues.
- Continue work with other agencies and non-profit land organizations on implementing CMPs for watershed protection forests.

Action Items

- Perform baseline surveys on all CR purchases.
- Monitor all of the Bureaus CRs.
- Pursue care and control agreements with other state agencies and non-profit land protection organizations.
- Monitor Chapter 61 properties to encourage more permanent forms of protection.

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5 Monitoring Programs

Monitoring the health of the watershed is at the core of the Bureau of Watershed Management's efforts to provide a clean water supply. Water quality sampling and field inspections help ensure compliance with state and federal water quality criteria for public drinking water supply sources. The Bureau also samples to better understand the responses of the reservoir and its tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the reservoir and the watershed.

BWM staff utilize state-of-the art techniques to test the water in the reservoir and its tributaries. Development impacts are closely monitored and mitigated through the Watershed Protection Act; the Bureau also relies on other state, local and federal laws to minimize the impacts of human activity. Environmental Quality Assessments (EQAs) are performed on sub-watersheds in a five-year cycle in order to identify potential water quality problems, seek out the source of the problem, and identify options for remediation.

5.1 *Water Quality Monitoring*

5.1.1 Watershed

Accomplishments:

- Continued routine tributary monitoring from over 50 sampling stations on 38 tributaries in the Wachusett Reservoir watershed.
- Continued supplementing routine water quality sampling program with biomonitoring to obtain a better understanding of fluctuations in water quality.
- Completed a report on the Wachusett tributaries that analyzes ten years of physical, chemical, and biological data, presents statistics, evaluates apparent trends, and ranks twenty-four streams with multiple years of available data using a variety of criteria.
- Continued to collect non-routine samples to document and support enforcement actions for events such as failed septic systems, illegal discharges, hazardous materials spills, and runoff from construction sites. Special samples were also collected to investigate, document, or remediate specific water quality issues throughout the watershed, including a study identifying sources of fecal coliform bacteria in the watershed, a long-term study on the impact of sewerage on a small urbanized subbasin, and studies on stormwater quality from different land uses.
- Continued use of stream gages to measure stream flow, including two continuous flow gages on the Quinapoxet and Stillwater Rivers.

Assessment:

Water quality sampling and watershed monitoring make up an important part of the overall mission of the Bureau. Water quality sampling and field inspections help identify tributaries with water quality problems, aid in the implementation of the Bureau's watershed protection plan, and ensure compliance with state and federal water quality criteria for public drinking water supply sources. Bacterial monitoring of tributaries provides an indication of sanitary quality and helps to protect public health. The Bureau also samples to better understand the responses of the tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the watershed.

Key Actions:

- Continue routine and non-routine water quality sampling and biological monitoring in the watershed.
- Complete a five-year update to the report by BWM focusing on ten years of fecal coliform bacteria and conductivity data on the Wachusett tributaries, which will further refine BWM's ability to establish priorities among watershed programs and subbasins.
- Continue use of stream gages to measure stream flow.
- Continue to work with UMASS to refine use of alternative source-specific indicators to help discriminate sources of microbial contamination
- Focus efforts on stormwater sampling to improve understanding of primary external source of reservoir contamination.

Background

Over the past fifteen years, water quality samples have been collected from 58 stations on 38 tributaries in the Wachusett Reservoir watershed (only a subset of stations, however, were sampled each year). Parameters measured included total and fecal coliform bacteria, conductivity, temperature, dissolved oxygen, pH, alkalinity, turbidity, selected nutrients and metals, hardness, color, and chlorides.

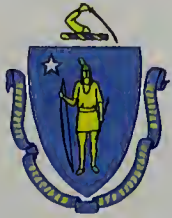
Current Program and Accomplishments**Water Quality**

Water quality samples were collected from 46 stations on 35 tributaries in 1999 and 2000 (see **Figure 5-1**). Samples have been collected from 20 stations on 15 tributaries for the past three years to facilitate analysis of total coliform and an increase in the frequency of sampling to capture storm event and post-event water quality.

Each tributary station was visited weekly throughout the year, with additional samples collected, when possible, during or following storm events. Temperature and conductivity were measured in the field using a Corning CD-30 conductivity meter and samples were collected for coliform analysis. All analyses were done at the BWM lab facility in John Augustus Hall in West Boylston. Samples for nitrate-nitrogen, nitrite-nitrogen, ammonia, silica, total phosphorus, UV-254, total suspended solids, and total organic carbon were collected monthly or quarterly from stations with available flow data (depth measurements were done to calculate flow using previously established USGS rating curves) and analyzed at the MWRA Deer Island Lab. Monthly samples for metals were collected from the Quinapoxet and Stillwater Rivers during 2002 and 2003 and sent to the MWRA as well.

Macroinvertebrates were collected during the spring from 13 stations on 11 tributaries in 1998 and from 23 stations on 20 tributaries in 2001. Additional samples were collected during the summer and fall of 2001 to investigate seasonal variations in Wachusett tributaries. Samples from 1998 have been identified and stream quality assessed by comparing results with historic data compiled over the past sixteen years.

Water quality data have been collected annually and a yearly summary published each spring by BWM since 1988. A ten-year report (1988-1997) was published in 1998 and is the first



BWM Sampling Station Locations Wachusett Reservoir Watershed



Statute Miles



Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management

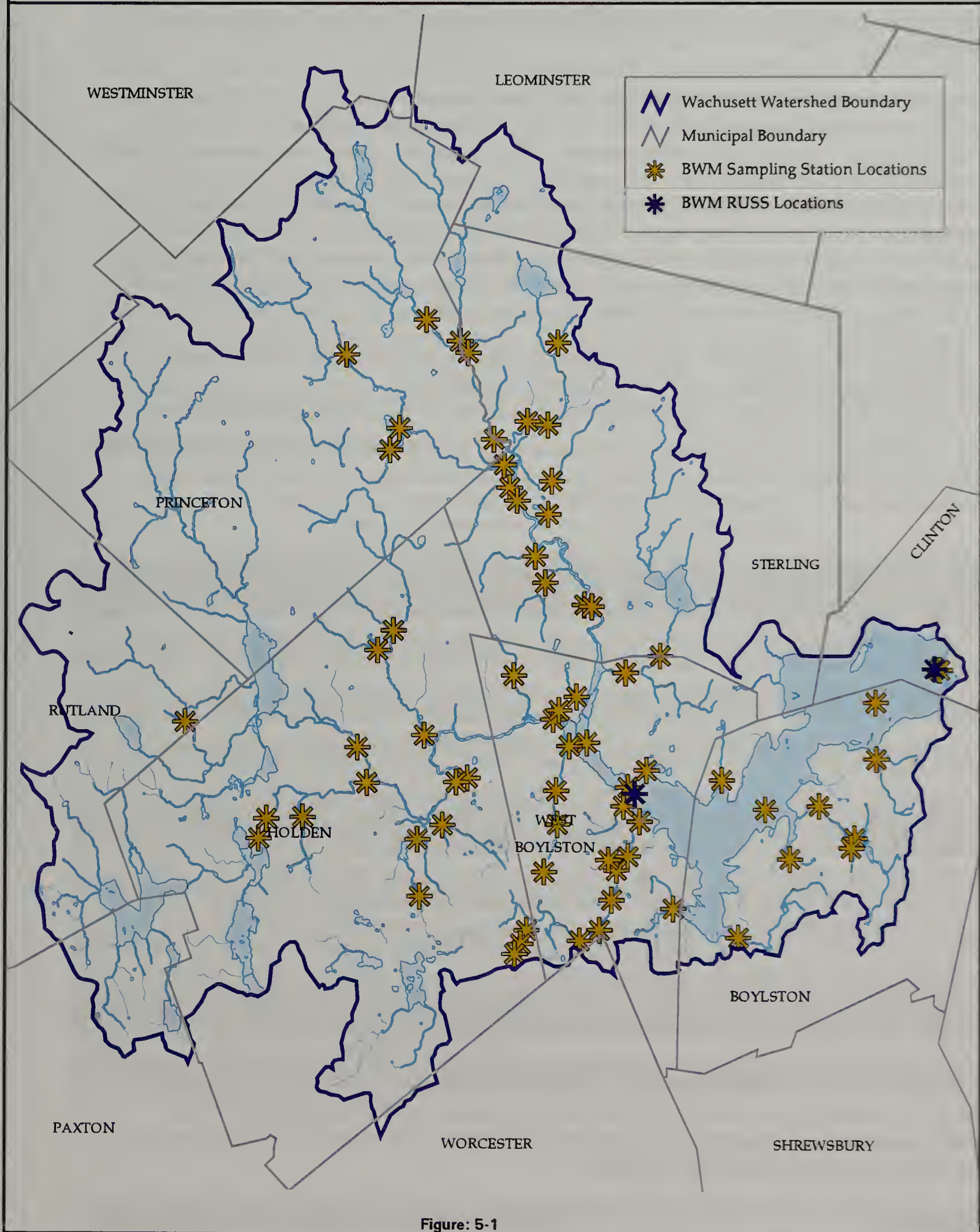


Figure: 5-1

comprehensive effort to summarize all data collected for Wachusett Reservoir watershed tributaries and to interpret long-term trends and rank tributaries based on water quality. BWM has been able to utilize this information to help locate sources of contamination and to prioritize investigations and remedial actions. Data gaps were identified and the knowledge used to focus sampling efforts and parameter choices.

BWM began a cooperative research relationship with the University of Massachusetts Department of Civil and Environmental Engineering in 1996 to investigate and develop methods to differentiate microorganisms found in watershed surface waters. The project aims to improve understanding of fecal coliform bacteria contamination in the watershed by testing various analytical methods and parameters to differentiate between contamination from humans and contamination from animals. Locating the source of fecal coliform bacteria is simplified if it is possible to first determine if the bacteria are from humans or animals. A comprehensive literature review was conducted to gather information on potential testing methods. Several methods were screened, and three tests were selected as having potential to identify the following microorganisms in the watershed system:

- *Bifidobacteria* - a bacterium which is a specific indicator of human fecal contamination.
- *Rhodococcus coprophilus* - a bacterium found in animals.
- *F specific RNA coliphage* - a bacteriophage which can identify human fecal contamination.

Working with BWM staff, UMASS researchers continue to develop and refine these tests to evaluate their ability to determine actual sources of fecal contamination, and for use by BWM staff in the water quality laboratory. A number of preliminary conclusions have been drawn:

- No strong correlations and linear relationships exist among established indicators and proposed alternative indicators.
- Source specific indicators cannot replace coliform to indicate pathogen risk.
- Source specific indicators are more applicable in highly developed settings than in less developed areas.
- Traditional coliform monitoring should continue in conjunction with measurements of source specific organisms. This will help with long-term watershed management and source water protection planning, and should help discriminate sources of microbial contamination.

BWM continues to collect data to document the positive impacts of sewerage in the watershed. Several years of baseline nutrient and bacteria levels have been collected in a small urbanized subbasin with numerous failing septic systems. More than a decade of routine water quality data from other subbasins with septic system problems also exists. Sewers are now in the ground in several of these subbasins and a significant number of homes connected, and both routine and stormwater samples were collected during 2003 to help illustrate water quality improvements.

Water quality data from the first six months of 2003 were compared with results from the similar period in 2002 and 2001 to see if any improvements could be seen. Most tributaries in the watershed had water quality in 2003 that was very similar to what had been measured during the previous two years. Median fecal coliform bacteria concentrations were nearly identical in many streams, as was the percentage of samples exceeding the state standard of 20 colonies per 100mL. Both metrics were sharply improved in five stations in Gates Brook, a highly contaminated urban tributary historically impacted by inadequate septic systems. Preliminary results suggest that the new sewer in this area has had a significant positive impact.

BWM is conducting a special monitoring program to characterize stormwater quality from three different land uses. UMASS has been able to focus on stormwater quality and different land uses in cooperation with BWM as part of a study, funded by the American Water Works Association Research Foundation, of three small subbasins in the Wachusett and Quabbin Reservoir watersheds. Data are being collected and a preliminary report on findings has been released. Source-specific indicators appear able to differentiate threats from different land uses, although there are various limitations associated with each indicator. Additional work is planned for 2004.

Flow

BWM staff estimate tributary flow when collecting water quality samples at the monitoring stations using established stage/discharge curves. The continuous stream gages are maintained through a contract with the USGS, and the resulting data are reported in the USGS annual reports. The work consists of monitoring, quality assurance/quality control, and publishing the data for fourteen stream gauges and two groundwater wells throughout the Wachusett Reservoir, Ware River, Quabbin Reservoir, and Sudbury Reservoir watersheds. The Stillwater and Quinapoxet River data are also real-time data retrieval stations and are accessible on the Internet. These allow the Bureau to associate sampling information with actual rainfall occurrence to establish relationships between pollutant loading and precipitation. Many of the other stream gauge data are used to monitor for compliance with minimum releases.

**Table 5-1
Wachusett Reservoir Watershed Stream Gauges**

NUMBER	DESCRIPTION	DATA PROVIDED
Stream Gauges		
01095220	Stillwater River, Sterling	Real-time data-Precip. Flow, Temp., Cond.
01095375	Quinapoxet River - Canada Mills, Holden	Real-time data-Precip, Flow, Temp., Cond.
01173000	Ware River, Intake Works, in Barre	Statutory Release Monitoring Requirement
01175500	Swift River, At West Ware	Statutory Release Monitoring Requirement
01170500	Connecticut River, Montague City	Statutory Release Monitoring Requirement
01098530	Sudbury River, Saxonville	Statutory Release Monitoring Requirement
01174500	East Branch Swift River near Hardwick	Supply Flow Monitoring. Pollutant Loading
01174565	West Branch Swift River near Shutesbury	Supply Flow Monitoring. Pollutant Loading
Other Stream Staff Gauges		
01095446	French Brook	Supply Flow Monitoring. Pollutant Loading
01095442	Malagasco Brook	Supply Flow Monitoring. Pollutant Loading
01095438	Muddy Brook	Supply Flow Monitoring. Pollutant Loading
10195434	Gates Brook	Supply Flow Monitoring. Pollutant Loading
01095420	W. Boylston Brook	Supply Flow Monitoring. Pollutant Loading
01095410	Malden Brook	Supply Flow Monitoring. Pollutant Loading
Groundwater Wells		
SYW 177	Rte 140 across from #160, Sterling	Monitor Local Conditions
WSW 26	Prescott St. South of Pleasant, W. Boylston	Monitor Local Conditions

Source: DCR/DWSP/BWM Wachusett Section EQ, 2003

USGS also evaluates and monitors staff gauges at six tributaries to the Wachusett Reservoir to update the rating curves every other year. These gauges are used to determine the flow in the tributary and to assess water volumes and pollutant loads entering the Wachusett Reservoir.

The USGS compiles and publishes data that historically was collected by the Bureau from eight groundwater wells. Due to budgetary cutbacks, monitoring was reduced to two sites in 2003. Groundwater levels are used to establish actual referenced groundwater elevations to aid the Bureau. Local conservation commissions and boards of health use the information to assess groundwater levels in a range of different soil types. These data helps these local boards to, respectively, define and apply corrections to groundwater levels determined for application of standards contained in the DEP Stormwater Policy and achieve compliance with Title 5.

Staff gauges for West Boylston Brook and French Brook are in disrepair due to activities of wildlife in the area and have not provided acceptable data since 2001. The Bureau and USGS identified improved locations and completed installation in the fall of 2003.

Assessment

Water quality in the tributaries over the past five years has remained relatively unchanged, although some significant improvements were recently detected in Gates Brook following the completion of a municipal sewerage system in the area. Most tributaries had annual median fecal coliform bacteria concentrations similar to those recorded over the previous ten years. A few showed minor water quality improvements; none exhibited a decline in water quality.

Further refinement of specific methods will enable the utilization of alternative indicators such as *E. coli*, *enterococcus*, Bifidobacteria, *Rhodococcus coprophilus*, and *F specific RNA coliphage* to better understand water quality and to prepare for changing EPA standards. The Bureau will also continue with routine monitoring, stormwater sampling, and macroinvertebrate collection to provide a complete understanding of watershed water quality

Control Approach

Goals

- To perform water quality sampling in order to help ensure compliance with state and federal water quality criteria for public drinking water supply sources.
- To better understand the responses of the tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the watershed.

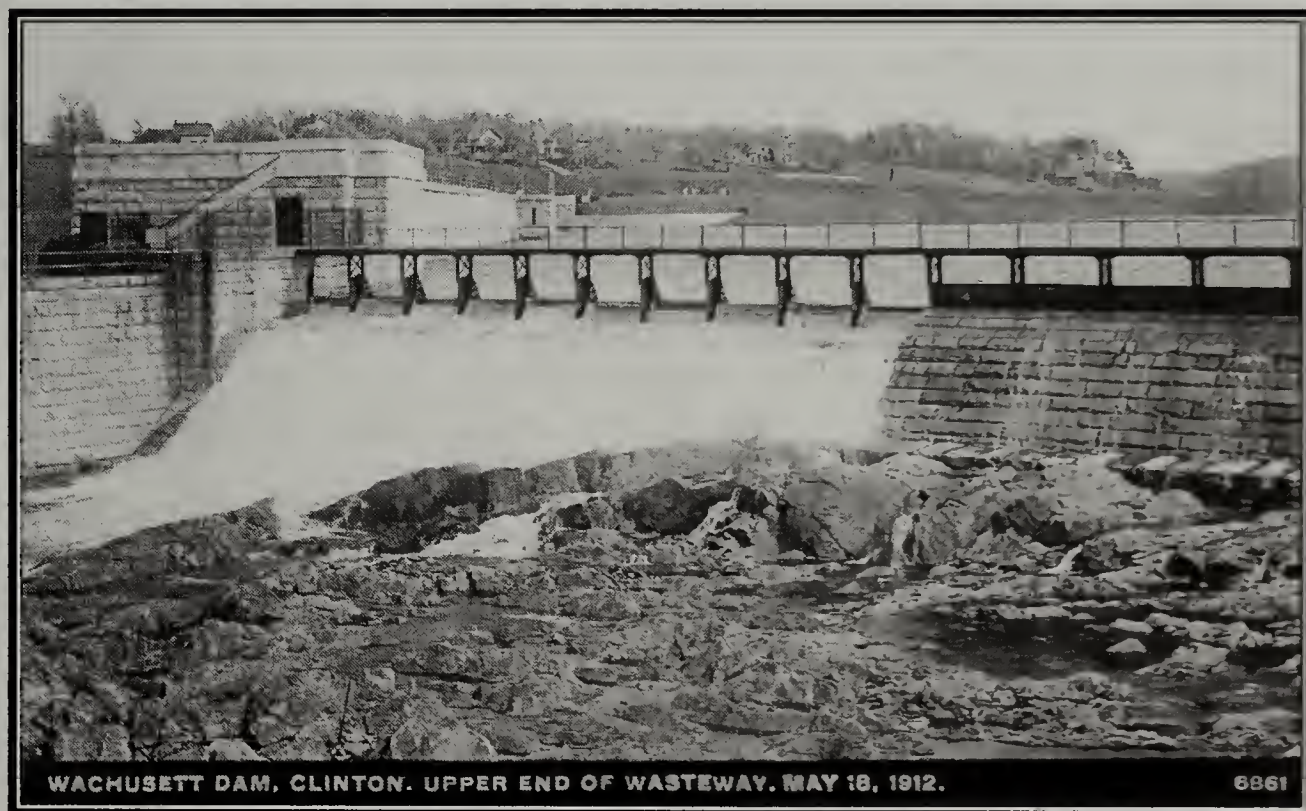
Objectives

- Sample tributaries with an emphasis on both dry and wet weather sampling, further documenting water quality under varying conditions.
- Closely examine updated water quality information in order to document changes and help focus additional remediation efforts.

- Use alternative indicators, biomonitoring, and special studies to improve the Bureau's understanding of current and future conditions in the watershed.

Action Items

- Continue routine and non-routine water quality sampling and biological monitoring in the watershed.
- Complete a five-year update to the report by BWM focusing on ten years of fecal coliform bacteria and conductivity data on the Wachusett tributaries, which will further refine BWM's ability in establishing priorities among watershed programs and subbasins.
- Continue use of stream gages to measure stream flow.
- Continue to work with UMass to refine use of alternative source-specific indicators to help discriminate among sources of microbial contamination
- Focus efforts on stormwater sampling to improve understanding of primary external sources of reservoir contamination.



5.1.2 Reservoir

Accomplishments:

- Continued routine reservoir monitoring at three reservoir locations. Installed two continuous, real-time Remote Underwater Sampling Stations (RUSS), providing significant additional water quality information.
- Monitored plankton populations in the Wachusett Reservoir in order to detect increasing concentrations (blooms), potential taste and odor problems, and to recommend, when necessary, copper sulfate treatment. Initiated sampling at Quabbin Reservoir to help further understand plankton population dynamics in the multi-reservoir system.
- Published two comprehensive summary reports describing plankton populations and nutrient dynamics in the Quabbin and Wachusett Reservoirs.
- Implemented a pilot treatment plan for plankton control developed by CDM for MWRA in 2001.
- Significantly lowered the detection limits for nutrients.
- Initiated Macrophyte (rooted aquatic plant) surveys in 1999 in order to detect alien species and characterize the reservoir macrophyte community. A colony of the invasive alien species Eurasian Water-milfoil was detected in the upper reaches of the reservoir in 2001; control efforts were immediately implemented and a long-range program initiated.
- Developed a two-dimensional water quality model of Wachusett Reservoir, which is being refined and calibrated under contract with the University of Massachusetts.
- A thorough understanding of the "Quabbin interflow" and its impact on reservoir water quality has led to better management of reservoir transfers in response to water treatment issues.
- Coordinated the Reservoir Operations Group, a forum for BWM and MWRA to exchange ideas and research results, and to update or modify operating policies for the Quabbin and Wachusett Reservoirs.

Assessment:

Water quality sampling is an important part of the overall mission of the Bureau, helping to identify water quality problems, aid in the implementation of the Bureau's watershed protection plan, and ensure compliance with state and federal water quality criteria for public drinking water supply sources. Bacterial monitoring of the reservoir provides an indication of sanitary quality and helps to protect public health. The Bureau also samples to better understand the responses of the reservoir to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the reservoir and the watershed.

Key Actions:

- Continue routine and non-routine water quality sampling (including plankton monitoring) in both reservoirs.
- Continue macrophyte control efforts to stop the spread of Eurasian Water-milfoil in the reservoir and to reduce the source population in the Stillwater Basin.
- Complete and utilize water quality model to assist with reservoir operations decisions.
- Continue to coordinate the Reservoir Operations Group.

Background

Over the past seventeen years, water samples have been collected from a number of stations on the Wachusett Reservoir. Parameters measured included total and fecal coliform bacteria,

phytoplankton, nutrients, conductivity, temperature, dissolved oxygen, pH, alkalinity, turbidity, and chlorides, although not all parameters were measured each year.

Historical measurements of nutrients in Wachusett Reservoir are documented in reports from two sampling programs conducted by private firms under contract with the Bureau. The consulting firm of Tighe & Bond conducted sampling and nutrient analysis of Wachusett Reservoir (and other BWM resource waters) from May 1986 through May 1988. A shortcoming of this study is that sampling was limited to surface grabs, which precluded the detection of vertical variations in the concentrations of certain nutrients, a major feature of the recently generated database.

Six years later the consulting firm of Camp, Dresser, & McKee (CDM) conducted sampling and nutrient analysis of Wachusett Reservoir from April 1994 through December 1994. Sampling at various depths in the water column was a component of this study and CDM results showed seasonal and vertical patterns consistent with more recent findings.

Both studies entailed field measurements and water sampling at a variety of locations across the basin. Many of the stations used for contemporary monitoring efforts are those originally established in these historical studies.

The main source of historical phytoplankton data is the program of weekly sampling since 1987 conducted off the catwalk at the rear of Cosgrove Intake. These samples have been supplemented for several years with additional sample locations that increased spatial coverage of the reservoir basin. All data have been recently reviewed and summarized as described below.

Current Program and Accomplishments

Water Quality

BWM collects monthly temperature, dissolved oxygen, pH, and conductivity profiles at three reservoir stations using a Hydrolab Surveyor III. Quarterly samples for nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, silica, alkalinity, and total phosphorus are collected at the same three stations and the Cosgrove Intake from three depths during thermal stratification and at two depths during isothermal conditions. All parameters are analyzed by the MWRA Lab at Deer Island using low detection limits.

Coliform samples are collected five times per week at the Cosgrove Intake to ensure compliance with federal regulations and to help monitor the effect of weather conditions, tributary inputs, and migratory gull and geese populations on bacteria concentrations. Coliform samples are also collected monthly, biweekly, or weekly at numerous locations on the reservoir surface, documenting the relationship between seasonal bacteria variations and roosting populations of gulls and geese on the reservoir as well as the impact of harassment on both birds and bacteria concentrations. A sampling grid with twenty-three sampling locations based on reservoir configuration and flow paths was utilized, and an additional sampling location near the dam was added in anticipation of withdrawals through the Wachusett Aqueduct in 2003.

Giardia and *Cryptosporidium* sampling is an important part of water quality monitoring, following the increased concern for these disease-causing agents throughout the drinking water industry. DWM began collecting pathogen samples in 1994. Routine sampling was discontinued in 2001 after the compilation of seven years of baseline data. No seasonal trends were identified; presence or absence appear to be related to precipitation and flow. The MWRA continues to collect weekly samples at the Cosgrove Intake, and samples are also collected from a tributary as part of the UMASS stormwater study.

Plankton samples are collected weekly or biweekly at the Cosgrove Intake and quarterly at three additional stations throughout the year when ice cover is not present. Sampling at the Quabbin Reservoir was done monthly for a year and continues on a quarterly basis at several stations. All data are transmitted weekly to the MWRA to enable time-sensitive decisions on potential copper sulfate applications. Two comprehensive summary reports describing plankton populations and nutrient dynamics in the Quabbin and Wachusett Reservoirs were published.

Nutrient and Plankton Dynamics in Quabbin Reservoir (MDC, 2002e) details the scope, methods, and results of an intensive program of monthly sampling and analysis of nutrients and plankton from October 1998 through September 1999. The frequency of sampling, spatial coverage (multiple depths at six stations) and improved analytical capability of the MWRA Deer Island laboratory provided the most comprehensive database available for Quabbin Reservoir. Major findings include marked seasonal and vertical variations in nutrient concentrations due to plankton dynamics, a slight horizontal gradient in silica concentrations correlated to hydraulic residence time, and an annual cycle of phytoplankton succession and abundance characteristic of many temperate, oligotrophic systems. These findings also helped develop a better understanding of similar processes in Wachusett Reservoir.

Beginning in October of 1998, Bureau staff initiated a year-long program of monthly sampling of Wachusett Reservoir at multiple stations and depths. The goal of this program was to document current nutrient and plankton dynamics and to update the existing database on nutrient concentrations and plankton characteristics. At the conclusion of monthly sampling in September 1999, a modified program of nutrient monitoring was continued on a quarterly schedule.

Nutrient and Plankton Dynamics in Wachusett Reservoir (MDC, 2003a) details the scope and methods of both the monthly and quarterly components of the monitoring program and presents an analysis of the results through December 2002. Also presented is a review of plankton data generated from BWM sampling conducted at Cosgrove Intake on a weekly basis (ice conditions permitting) since 1987 and supplemental reservoir sampling conducted in 1988, 1989, 1995, and 1996. The report integrates historical nutrient and plankton data generated from studies of Wachusett Reservoir contracted by the MDC/DWM and completed prior to 1998.

A pilot treatment plan for plankton control was developed by CDM for MWRA in 2001. The study proposed dispersion of copper sulfate using air-lift mid-depth circulators to treat nuisance plankton during difficult weather or ice-covered conditions, or when problem species are located well below the surface and control using a surface application would be ineffective.

The pilot treatment plan was tested during the summer and fall of 2001 using a single circulator and Rhodamine WT dye to simulate dispersion of liquid copper sulfate. The circulator was placed

between 15 and 25 meters deep during the summer and between 5 and 15 meters deep during the fall. The circulator was anchored to the bottom of the reservoir and attached to a floating barge outfitted with a propane-fueled air compressor. Several dye treatments were attempted and the results published by CDM in 2002. Although the piloting was viewed as generally successful, full scale implementation was not proposed at that time due to budget priorities and the success to date of traditional surface application.

Samples collected by BWM and MWRA are analyzed at the MWRA laboratory on Deer Island. There is a need for BWM to be able to analyze nitrogen and phosphorus at very low levels, and MWRA laboratory staff currently use low-level detection methods that are not readily available through commercial laboratories. Since BWM no longer needs to award contracts to commercial laboratories through a bidding process, the relationship with the MWRA laboratory enables BWM to avoid possible data gaps or comparability issues among different commercial labs. All nutrient data from July 1998 to present was done using low-level methods.

A two-dimensional water quality model of Wachusett Reservoir has been developed, and is being refined and calibrated under contract with the University of Massachusetts. Details of this project are found in Section 8.4.

Flow

The transfer of water from Quabbin to Wachusett Reservoir via the Quabbin Aqueduct has a profound influence on the water budget, profile characteristics, hydrodynamics, and water quality of the Wachusett Reservoir. During the years 1995 through 2002, the amount of water transferred annually from Quabbin to Wachusett ranged from a volume equivalent to 44 percent of the Wachusett basin up to 94 percent. The period of peak transfer rates generally occurs from June through November. However, at any time of the year, approximately half of the water in the Wachusett basin is derived from Quabbin Reservoir.

The peak transfer period overlaps the period of thermal stratification in Wachusett and Quabbin Reservoirs. Water entering the Quabbin Aqueduct at Shaft 12 is withdrawn from depths of 13 to 23 meters in Quabbin Reservoir. These depths are within the hypolimnion of Quabbin Reservoir where water temperatures range from 9 to 13 degrees C in the period June through October. This deep withdrawal from Quabbin is colder and more dense relative to epilimnetic waters in Wachusett Reservoir. However, due to a slight gain in heat from mixing as it passes through Quinapoxet Basin and Thomas Basin, the transfer water is not as cold and dense as the hypolimnion of Wachusett. Therefore, Quabbin water transferred during the period of thermal stratification flows conformably into the metalimnion of Wachusett where water temperatures and densities coincide.

The term interflow describes this metalimnetic flow path for the Quabbin transfer that generally forms between depths of 7 to 15 meters in the Wachusett water column. The interflow penetrates through the main basin of Wachusett Reservoir (from the Route 12 Bridge to Cosgrove Intake) in about 3 to 6 weeks depending on the timing and intensity of transfer from Quabbin. The interflow essentially connects Quabbin inflow to Cosgrove Intake in a "short circuit" undergoing minimal mixing with ambient Wachusett Reservoir water.

Two in situ monitoring buoys known as Remote Underwater Sampling Stations (RUSS) were first deployed for seasonal data collection at Wachusett Reservoir in late April 2002. One is located in the main body of the reservoir just outside of Thomas Basin at the southwestern end and the other is located just off Cosgrove Intake at the northeastern end. These two locations represent essentially the two extreme ends of the main body of the reservoir and permit the monitoring of water quality as the principle inflows from the Quinapoxet River, Stillwater River, and the Quabbin Reservoir transfer (interflow) pass from Thomas Basin northeast to the Intake (see **Figure 5-1**). The buoys allow several depth profiles to be collected each day without the deployment of staff in boats.

Both buoys are fitted with Hydrolab data collection instruments. Data are collected four times each day at the Cosgrove Intake area buoy. Each run has 23 depth readings for pH, temperature, turbidity, and conductivity, which are communicated via cellular phone to a land-based computer. Data are collected two times each day at the Thomas Basin buoy and each run has 16 depth readings. Data collected since the buoys have been in place have resulted in some preliminary findings, which will aid in reservoir management decision-making. These include the following:

1. An analysis of Quabbin Reservoir interflow arrival time at Cosgrove Intake was performed by using daily samples from the buoys. For example, in late 2002, using conductivity measurements to track Quabbin water, it was observed that the Thomas Basin buoy conductivity dropped off rapidly and then leveled out after 50 days. Comparing this with existing data from 1998 through 2002, and the start of Quabbin water arrival time at Cosgrove Intake, it was found that the arrival time depends in part on when the transfer is started, and generally, the more water that is transferred the faster it moves. It was also found that a significant factor in travel time is the strength of the stratification level of the reservoir.
2. In comparing recorded wind data at the time of buoy sampling, it has been observed that a wind threshold of about 10 mph appears to change the reservoir water temperature/conductivity relationships as water is driven down and mixes.
3. Reservoir turnover can be assessed as it is occurring.

These factors help determine optimum transfer periods for Quabbin water. The buoys also have provided information on rates of change of physical conditions and water quality parameters, and provide the ability to develop baseline data for future research. This may prove beneficial to ongoing modeling efforts underway in conjunction with the University of Massachusetts (Amherst) Department of Civil and Environmental Engineering.

A thorough description of the "Quabbin interflow" and its impact on reservoir water quality can be found in a recent summary of nutrient and plankton dynamics in Wachusett Reservoir (MDC, 2003a). In addition to positive impacts on nutrient and plankton concentrations, the lower organic content in water transferred from Quabbin results in lower disinfection byproduct formation at the Cosgrove Intake. Understanding the interflow and how it impacts water quality has led to better management of reservoir transfers in response to water treatment issues.

Macrophytes

Routine macrophyte (rooted aquatic plant) surveys of Wachusett Reservoir were initiated by MDC staff in 1999. Surveys consist of visual observations and mapping of littoral zone vegetation from a boat. Each survey effort generally focuses on a discrete shoreline area and is often performed in conjunction with other field activities involving boat operation. Observations of macrophytes growing at depth are aided by the use of a view box. Specimens are collected with a rake or grab when needed to facilitate plant identification.

The macrophyte flora of Wachusett Reservoir is composed of approximately twenty species including three species non-native to Massachusetts. In August of 2001, a pioneering colony of Eurasian Water-milfoil (*Myriophyllum spicatum*; referred to subsequently as “milfoil”) was observed for the first time in Upper Thomas Basin, a small basin in the upper reaches of the reservoir system. A milfoil control program was implemented for the 2002 growing season with funding provided by MWRA and technical assistance from BWM. The consulting firm Aquatic Control Technology, Inc. of Sutton, Massachusetts was selected to conduct a variety of control techniques aimed at eliminating the infestation in Upper Thomas Basin, preventing the establishment of new plants, and restricting the dispersal of autofragments* downgradient to other portions of the reservoir system. The primary control methods used were benthic barriers and hand-harvesting. Benthic barriers are sheets of material installed over bottom substrates to smother existing plant infestations and to prevent colonization of the substrate. Hand-harvesting consists of SCUBA divers physically uprooting specimens of milfoil and removing the plants by hand. The program is continuing during the summer of 2003. Alternative control measures for the heavily infested area upstream of the reservoir were discussed, and a contract for biological control using native aquatic weevils was initiated in the 2003 growing season.

Reservoir Operations

In mid-1998, MWRA and MDC/DWM began to more formally coordinate reservoir operations by holding periodic Reservoir Operations Group meetings. These gatherings have evolved into quarterly meetings and include a range of staff charged with physical, chemical and biological assessments, water elevation maintenance and inter-reservoir transfers, security and emergency response, and special projects.

The group is comprised of MWRA staff and managers from Western Operations, Field Operations, Planning, and Laboratory Services. BWM staff and managers include superintendents of Wachusett Reservoir and Quabbin Reservoir, Environmental Quality, and laboratory personnel. The Water Supply Citizens Advisory Committee (WSCAC) often attends and actively participates in these meetings.

Discussions are routinely held on plankton control, gull harassment, water quality (including monitoring buoys), Ware River diversions, and general reservoir operations, each of which has unique seasonal variations requiring significant coordination. Other timely topics that continue to be prominent include Eurasian milfoil control, construction coordination for MWRA's Integrated Water

* Milfoil autofragments are stem segments with adventitious roots at the nodes that float upon abscission and are the plant's most important mode of reproduction and dispersal. Autofragments of *M. spicatum* eventually sink to the bottom and are capable of colonizing littoral zone areas having only minimal deposits of organic sediment.

Supply Improvement projects (see **Section 7.2**), security issues and pre-positioned deployment of spill-containment equipment, and reservoir transfer protocols.

The Reservoir Operations Group is a forum not only for management of water resources and system operations, but also for coordination and information transfer from research efforts to operational decision-making. Agendas are set and minutes kept of all deliberations.

The Bureau has reinstituted routine monitoring of the snow pack (depth and water content) to help predict spring runoff and aid in reservoir operations decisions.

Assessment

Nutrient and plankton dynamics, and the “Quabbin interflow” and its impact on reservoir water quality, have been described in detail in Sections 2.3, 2.4, and 5.1.2. Water quality in Wachusett Reservoir remains very high, with only minor taste and odor episodes due to plankton and no exceedences of federal or state drinking water standards for fecal coliform bacteria since March of 1999.

Control Approach

Goals

- To perform water quality sampling in order to help ensure compliance with state and federal water quality criteria for public drinking water supply sources.
- To better understand the responses of the reservoir to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the watershed.

Objectives

- Sample the reservoir on a daily, weekly, monthly, and quarterly basis to further document water quality under varying conditions.
- Continue ongoing efforts to keep invasive macrophytes out of the reservoir and to reduce source populations.
- Cooperate with UMASS and the MWRA to further develop and implement reservoir models and utilize information gathered to make sensible reservoir operations decisions that improve or maintain water quality.

Action Items

- Continue routine and non-routine water quality sampling (including plankton monitoring) in Wachusett Reservoir.
- Continue macrophyte control efforts to stop the spread of Eurasian Water-milfoil in the reservoir and to reduce the source population in the Stillwater Basin.
- Complete and utilize water quality model to assist with reservoir operations decisions.
- Continue to coordinate the Reservoir Operations Group.

5.2 Project Monitoring

5.2.1 Watershed Protection Act

Accomplishments:

- Continued ongoing administration of the Watershed Protection Act (WsPA). Over 500 applications were reviewed during the past five years.
- Updated all forms, Guidance Document and the Watershed Protection Act brochure. Created a new brochure entitled "Landscaping and the Watershed Protection Act." All material was posted on the Bureau's website.
- Continued meetings of the Watershed Protection Act Working Group (WsPAWG) on a regular basis.
- Continued formal and informal contact with local Boards regarding the Watershed Protection Act.

Assessment:

Watershed Protection Act review has resulted in more sensitive land development. Some projects have been relocated further away from resource areas. Other construction resulted in less dense development of the land or implementation of additional mitigation measures. Staff continue to review development projects outside of priority resource areas, promoting watershed-wide resource protection.

Key Actions:

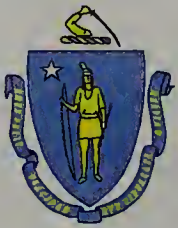
- Continue ongoing administration of the Watershed Protection Act.
- Revise ownership information resulting in an updated database.
- Continue to meet with the Watershed Protection Act Working Group.
- Work with towns, general public and other agencies to review projects in the watershed.

Background

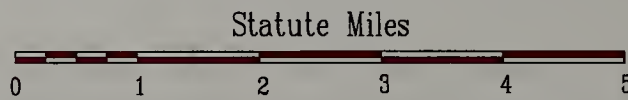
The Watershed Protection Act (WsPA) is a law passed in 1992 by the Commonwealth (St. 1992, c. 36). This legislation – also known as the "Cohen Bill" after its initial sponsor, former State Representative David Cohen of Newton – directed the Metropolitan District Commission, Division of Watershed Management (MDC/DWM) to adopt regulations, 350 CMR 11.00, to help protect the sources of water to the reservoirs that provide drinking water to 2.2 million people. The WsPA establishes a "comprehensive scheme to regulate land use and activities within certain critical areas" of the Quabbin Reservoir, Wachusett Reservoir and Ware River watersheds (see **Figure 5-2**).

Many aspects of the use and development of land affect the quality of nearby streams which then flow into reservoirs and other sources of water supply. Type of development, density, amount of paved surface, and proximity to river banks are contributing factors to the amount and types of pollutants that can end up in a stream. Some of the strategies used by the WsPA to minimize the effects of human activities on water quality include: preserving a buffer zone along the water resources, limiting impervious surfaces, and restricting the storage and use of hazardous materials.

Through the Act and its regulations, the BWM seeks to avoid detrimental land uses close to water resources and guide development into more appropriate locations, densities and configurations. Two different areas are protected under the WsPA (see **Figure 5-3**; for a complete description, see 350 CMR 11.04).



Watershed Protection Act Regulatory Zones and Application Sites



Dept. of Conservation and Recreation
Div. of Water Supply Protection
Bureau of Watershed Management

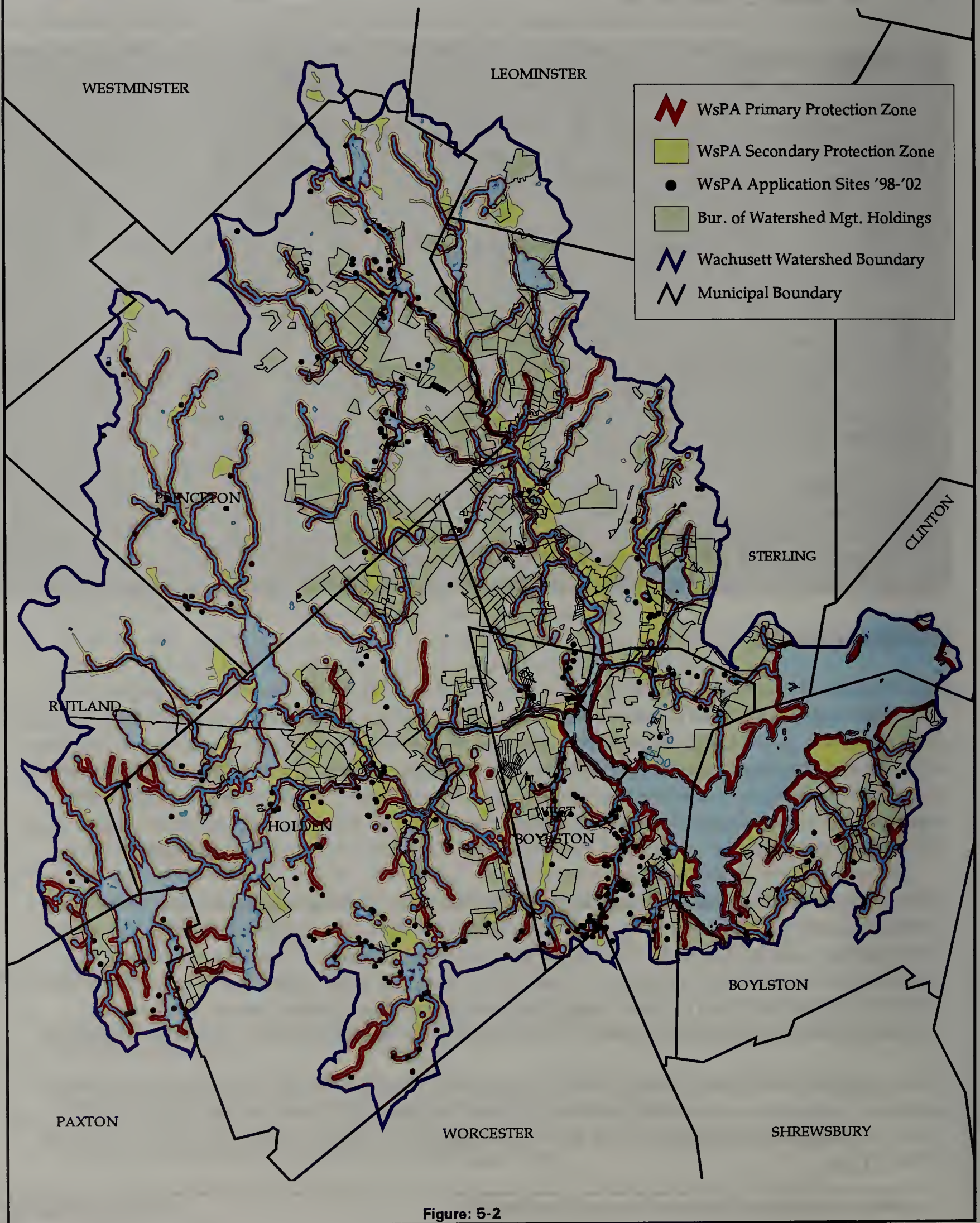
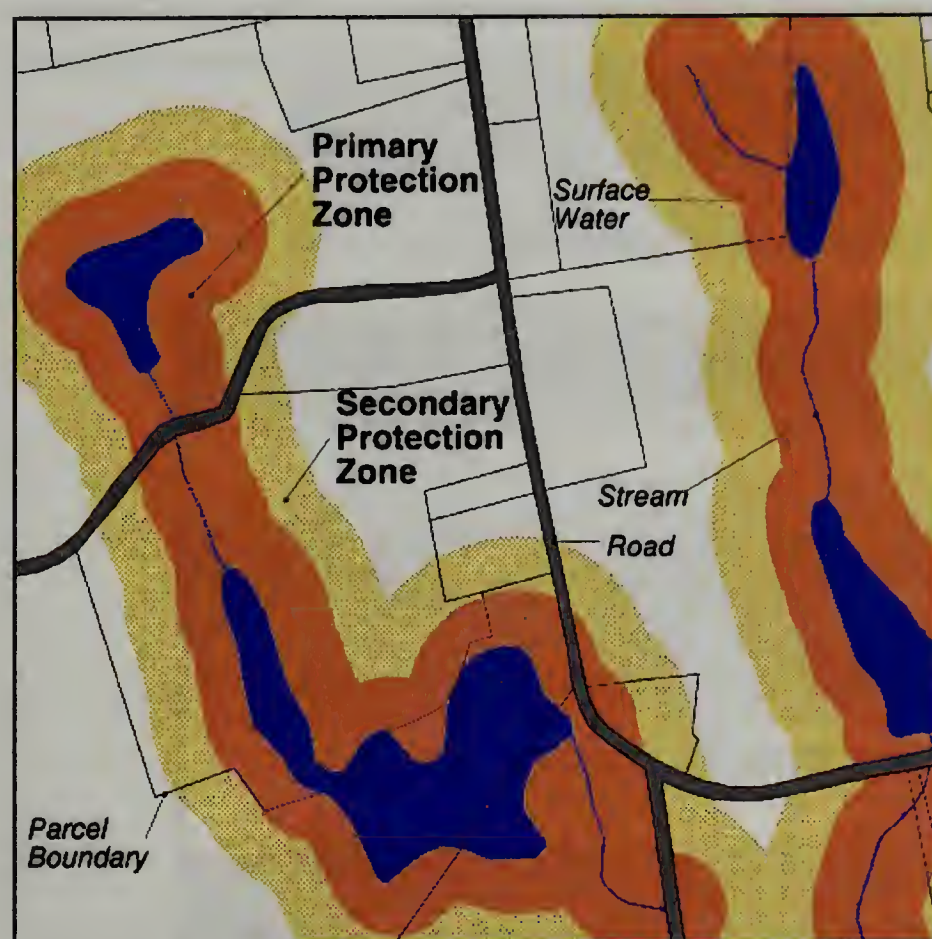


Figure: 5-2

Figure 5-3: WsPA Protection Zone Illustration



- **Primary Protection Zone:**
Within 400 feet of the reservoirs and 200 feet of tributaries and surface waters, any alteration is prohibited. "Alteration" includes a variety of activities, such as draining, dumping, dredging, damming, discharging, excavation, filling or grading. Generation, storage, disposal or discharge of pollutants is also prohibited in the Primary Protection Zone.
- **Secondary Protection Zone:**
Between 200 and 400 feet of tributaries, surface waters, and on land within flood plains, over some aquifers, and within bordering vegetated wetlands, certain activities are

specifically prohibited. These activities include: storage, disposal or use of toxic, hazardous, and certain other materials; alteration of bordering vegetated wetlands; and dense development.

The WsPA affects close to 5,000 individual parcels in the Wachusett Reservoir watershed (see **Table 5-2**). The Bureau provides a variety of scenarios for individual property owners to determine whether their parcel is affected by the Act, and if so, whether a proposed activity is either allowed or prohibited by the regulations. Property owners affected by the Act in 1992 received written notification of their status when the law took effect. Ownership, however, changes over time; current property owners can check the location of their parcel relative to the WsPA Protection Zones on maps available at town halls and BWM Field Offices.

Table 5-2
Watershed Protection Act Affected Areas

Watershed	Number of Affected Parcels	Acreage Affected by WsPA			
		Primary Protection Zone	Secondary Protection Zone	Total	Percent of Watershed
Wachusett Reservoir	4,903	5,725	6,580	12,305	17.4%
Ware River	2,221	3,548	4,265	7,813	12.7%
Quabbin Reservoir	1,260	3,628	4,008	7,636	8.0%
Total	8,384	12,901	14,853	27,754	12.2%

Source: DCR/DWSP/BWM, 2003

Owners are recommended to make an inquiry to the BWM if there is a proposed change on the site regarding the use, physical structures, new construction, or any other activity modification. The kind of application submitted will depend on the circumstances of the applicant and the proposed project (see Table 5-3).

Table 5-3
Watershed Protection Act Applications

Type of Application <i>[What to Submit]</i>	BWM Response <i>[Form of Response]</i>
Advisory Ruling <i>[Letter from Owner]</i>	Informal indication of whether property is affected, if activity is prohibited, if exemption applies. <i>[Letter from BWM]</i>
Determination of Applicability <i>[WsPA Form 1]</i>	Formal, recordable indication of whether property is affected, if activity is prohibited, if exemption applies (may include water quality finding). <i>[WsPA Form 2]</i>
Variance <i>[WsPA Form 3]</i>	Decision whether physical characteristics allow law to be varied for this project without water quality degradation or harm to public good. <i>[WsPA Form 4]</i>
Exemption of a Tributary <i>[WsPA Form 5]</i>	Decision whether several factors allow tributary or portion to be exempted without risk of water quality degradation or harm to public good. <i>[WsPA Form 4]</i>

Source: DCR/DWSP/BWM Planning, 2003

Current Program and Accomplishments

BWM staff reviewed 564 WsPA application between January 1998 and June 2003. The majority of these applications were for Advisory Rulings or Determinations of Applicability. There were 39 Variances granted during this time period (see Table 5-4 and Figure 5-4).

Staff revised all forms and the brochure used in administration of the Watershed Protection Act. These forms include the Request for Watershed Determination of Applicability, Applicability Decision, Application for Variance, and Variance Decision. The Guidance Document, used mainly by those seeking a Variance Decision, was also updated.

Figure 5-4: WsPA Applications January 1998 – July 2003

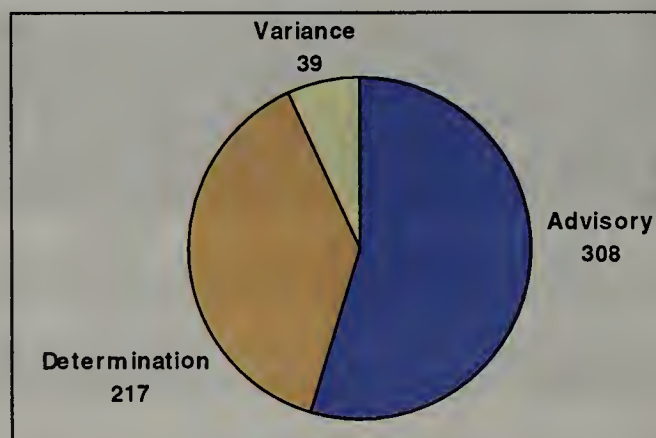


Table 5-4
Summary of WsPA Applications 1998 - 2003

Land Use	# of Applications	% of Total Applications
Residential – Single Family	128	23%
Residential – Multi-Family	9	1%
Residential – Addition	79	14%
Residential – Accessory Use	120	21%
Residential – Septic System	32	6%
Subdivision – minor	9	1%
Subdivision – major	21	4%
Commercial Use	46	8%
Municipal Use	26	5%
Agriculture – existing	2	< 1%
Agriculture – new	1	< 1%
Redevelopment – commercial	16	3%
Redevelopment – municipal	4	< 1%
Right-of-Way – utilities	3	< 1%
Right-of-Way – trains	0	0%
Right-of-Way – roads	18	3%
Other	33	6%
Location Only(No activity)	17	3%
Total	564	100%

Source: DCR/DWSP/BWM Wachusett EQ, 2003

The intent in updating the WsPA forms was to provide as much information to the public as possible, clearly explaining the application, the application process and the decision. In addition, the general WsPA brochure was updated and is now printed in color to better assist and answer questions from the public. A new brochure entitled “Landscaping and the Watershed Protection Act” was developed to help answer questions about how landscaping activities can meet the WsPA regulations.

All of the above information is available to be mailed out to all those who request information on the regulations as well as being posted on the BWM website.

The Watershed Protection Act Working Group (WsPAWG) continues to meet to provide staff from the Quabbin, Wachusett and Boston sections and an MWRA representative the opportunity to consult on general issues, discuss specific cases and apply past precedents. This group also discusses interagency coordination efforts.

Issues that are not necessarily subject to the WsPA but still require BWM attention are referred to other members of the Environmental Quality section. Two examples would be areas of dumping and projects located outside the buffer zones that may potentially impact water quality but would not be regulated under the Watershed Protection Act.

Contact with boards and commission is ongoing and will continue. Staff visit various Town Halls to inquire about proposed projects, discuss current projects, and drop off new maps and brochures. During this time, BWM staff also speak with town staff and answer any questions that may arise about the regulations.

A reorganization of the Wachusett/Sudbury Reservoir Section placed WsPA related duties within the Environmental Quality staff. This realignment creates the opportunity for a more comprehensive approach to reviewing and tracking all development projects within the watershed and the integration of these efforts with the Environmental Quality Assessments (see **Section 5.3**).

Updating the parcel database utilized for WsPA implementation has been an ongoing project for BWM. Several attempts have been made to institute a comprehensive process to update the private landowner's parcel data for the entire Watershed System in the BWM GIS. The different options explored include:

- Towns update the GIS data themselves (ongoing)
- BWM staff update data (1998 – 1999)
- BWM contract with a vendor (2000 – 2001)
- BWM coordinate with MassGIS (2002)

In the Spring of 2001, MDC entered into a contract with Applied Geographics, Inc. to update the coverages for a pilot project to update the data for three towns: Princeton, Hubbardston, and Phillipston. BWM staff are working on integrating these new data into the existing GIS system.

Assessment

The Watershed Protection Act does not stop development, rather it prohibits certain activities while promoting improved site designs in order to better protect water quality. BWM staff work with landowners to ensure that their projects meet the WsPA regulations. This work entails spending a significant amount of time with property owners and/or their representatives (e.g., realtors, lawyers, engineers) to review their proposals, visit the project sites, and provide clear guidance on how different design alternatives will best meet the requirements of the Act. The final plan submitted to BWM after this dialogue is usually much more protective of all the natural resources on the property. For example, residential areas have been developed less densely, individual homes have been sited away from resource areas, and commercial/industrial projects have been revised to include mitigation measures to protect the water supply. Communication and coordination with the watershed towns is also an important element to the Act's successful implementation.

Another key factor in implementing the WsPA is the maintenance of an accurate GIS database. Analysis of the pilot contract with Applied Geographics (see description above for Princeton) concluded that utilization of an outside vendor will not be an effective long-term solution to updating the BWM parcel data. Two key reasons for this conclusion are: 1) the contractor stated that they under-bid the contract and any subsequent work would have significant cost increases (probably into the six-figure range); and 2) attempting to do this kind of work for the BWM rather than for the town itself greatly hinders the access and cooperation required to undertake such a complex task.

The preferred solution to this process is for the towns to digitally maintain their assessor data. This option is coming closer to reality as computers become more powerful and GIS more accessible. The larger towns are starting to use this technology out of necessity. The initiation of a grant program by MassGIS specifically to fund these efforts also helps make this solution possible. Once a critical mass of the towns in the watershed start maintaining digital assessor's data, BWM can concentrate the limited amount of staff time on the remaining areas that could be updated in-house.

Control Approach

Goals

- To prevent impacts to water quality from development in the most critical areas of the BWM water supply watersheds.
- To provide fair and consistent interpretation of the WsPA regulations and timely review and decision making on property applications.
- To utilize the regulations to educate land owners and town officials about the effects of development on water quality and ways to mitigate these impacts.

Objectives

- Implement and enforce all provisions of the WsPA regulations.
- Administer the Act with consistency and fairness.
- Communicate effectively with land owners, town officials, other agencies, and the general public on the WsPA.

Action Items

- Continue to administer individual applications under the Watershed Protection Act regulations.
- Continue to meet with the Watershed Protection Act Working Group.
- Refer development projects not regulated by the WsPA for appropriate review and tracking by Environmental Quality Section staff under other statutory authority.
- Update parcel information in the GIS database.

5.2.2 Watershed Protection and Other Environmental Regulations

Accomplishments:

- Identified and researched possible violations of environmental regulations.
- Developed and implemented draft enforcement protocol with DEP.
- Coordinated with other state agencies in reviewing projects that are subject to various and often multiple, overlapping regulations (e.g., Right-of-Way pesticide/herbicide application, Title 5 on-site wastewater treatment, agricultural sites, private forestry practices, and 21-E state regulated sites).
- Reviewed and commented on proposed changes to state regulations.

Assessment:

There is a broad array of federal, state and local laws and regulations that act as a significant control against potentially polluting activities on private lands throughout the Wachusett Reservoir watershed. While implemented by other entities, BWM staff presence in the watershed can enhance the administration and enforcement of these laws, resulting in a higher rate of compliance. Control of regulated sites and activities through these regulations has minimized the threat these sites pose to water quality.

Key Actions:

- Maintain vigilance locating possible violations of environmental regulations.
- Review enforcement protocol with DEP.
- Continue to coordinate with other state agencies to assist with their regulatory enforcements.
- Continue to review proposed changes to state environmental regulations and local bylaws.

Background

The Commonwealth of Massachusetts and the U.S. Environmental Protection Agency (EPA) have a broad range of laws and regulations collectively aimed at reducing and controlling environmental pollution. **Table 5-5** summarizes key laws and regulations most commonly utilized by BWM staff (including BWM regulations), relevance of the regulations to watershed protection, and the enforcement authority.

During the development of the WsPA regulations (350 CMR 11.01-11.08, **see Section 5.2.1**), the opportunity was taken to streamline all other MDC-related watershed protection regulations into one concise section, 350 CMR 11.09. These rules prohibit any action which could degrade the Waters of the Watershed System (constituting the Wachusett Reservoir, Quabbin Reservoir, Ware River, and Sudbury Reservoir watersheds), or interfere with their use as a source of water supply. Except for specific WsPA related violations, this comprehensive set of regulations is the basis for any enforcement action taken by the Bureau. Coordination with the other local, state and federal environmental statutes provides several avenues to protect water quality.

Table 5-5
Environmental Regulations Employed in Watershed Protection Activities

Regulation	Authority	Issue	Relevance	BWM Role¹
350 CMR 11.01-08	BWM	Watershed Protection	Provisions of the Watershed Protection Act; establishes protective buffers around resource areas.	Lead administrator. Discussed in Section 5.2.1.
350 CMR 11.09	BWM	Watershed Protection	Prohibits any action which could degrade the Waters of the Watershed System or interfere with their use as a source of water supply.	Lead administrator.
310 CMR 15.00 "Title 5"	DEP <i>Administered locally by board of health</i>	Subsurface Sewage Disposal	Regulates siting, design, and inspection of on-site systems.	Review water quality, other data to screen for sites. When potential problems arise, work with BOH to resolve.
310 CMR 10.00	DEP <i>Administered locally by conservation commission</i>	Wetlands	Restricts alteration and/or filling of wetlands; requires review of all projects within 100 feet of wetlands or within floodplains.	Work with conservation commission to see that regulations are followed by property owners.
310 CMR 13.00	DEP <i>Administered locally by conservation commission</i>	Rivers Protection Act	Establishes protected wetland resource area – riverfront.	In most cases, riverfront resource area = primary protection zone of WsPA.
40 CFR Parts 9, 122, 123 and 124	EPA <i>Administered by DEP</i>	Stormwater Phase II	Replaces/augments DEP Stormwater Management Policy: part of NPDES program.	Discussed in Section 6.2.
310 CMR 40.0000	DEP	Hazardous Waste Site Cleanup (Mass Contingency Plan)	Establishes a process for prioritization, investigation, and cleanup of hazardous materials releases.	RP submit copies of all reports to BWM for review; when necessary comments made to RP and/or DEP.
310 CMR 40.0000	DEP	Underground Storage Tanks	Regulates design and construction of new or replacement tanks.	BWM monitors information.
527 CMR 4.00 & 9.00	DFS, local fire department	Underground Storage Tanks	Removal, installation and maintenance of USTs.	BWM monitors information.

Regulation	Authority	Issue	Relevance	BWM Role¹
304 CMR 11.00	DCR	Forest Cutting Practices Act	Regulates how forests are managed.	Discussed in Section 6.4.2.
301 CMR 11.00	EOEA	Massachusetts Environmental Policy Act (MEPA)	Requires comprehensive environmental assessment and public review of major projects.	Per MEPA regulations, BWM should receive copies of all watershed projects; BWM reviews and comments on projects. Any project requiring a WsPA Variance, except for a Single Family House, requires the filing of an ENF.
333 CMR 1.0 to 12.0	DAR	Pesticide Regulations	Restricts type and location of pesticides; requires filing of 5-year Vegetative Management Plans and annual Yearly Operating Plans.	BWM reviews VMPs and YOPs in the watershed to see that resources are correctly identified; review applications to ensure that no spray areas are observed.

Source: DCR/DWSP/BWM. 2003; DEP – see www.state.ma.us/dep/matrix.htm.

¹ BWM may have overlapping jurisdiction if parcel is subject to the Watershed Protection Act (See Section 5.2.1).

These laws and regulations act as a significant control over potentially polluting activities on private lands. This section discusses the protection afforded by this body of laws, their enforcement within the Wachusett Reservoir watershed, and BWM's role in enhancing their administration and enforcement.

Current Program and Accomplishments

The 1998 Plan called for continued MDC presence and surveillance in the watershed, and improved coordination with DEP and other agencies with regulatory responsibilities. MDC and DEP developed and signed a Standard Operating Procedures document for joint compliance and enforcement. The Bureau developed a database and tracking system for sites investigated in the watershed under 350 CMR 11.09.

In 2002, problems were reported and investigated on 80 sites. Issues investigated included problems with on-site wastewater disposal, erosion into resources from construction sites, chemical releases, illegal dumping, and flooding caused by beaver impoundments. Problems were resolved at 65 of the sites. Staff continues to monitor the other 15 sites and work with the owners and appropriate agencies to see that the issues are resolved.

Assessment

There is a strong framework of environmental laws and regulations that provides protection of the water resources in the Wachusett Reservoir watershed. Bureau staff work to coordinate these laws and regulations with BWM's own regulations.

Control Approach

Goals

- To work cooperatively with appropriate agencies towards maximum feasible compliance with all environmental regulations.
- To be consistent in application and interpretation of regulations.

Objectives

- Work with appropriate authority to ensure that all environmental regulations are followed.
- Integrate all relevant BWM regulations with appropriate environmental regulations administered by other federal, state and local authorities.
- Monitor compliance with all environmental regulations through water quality testing, EQAs, and general watershed surveillance

Action Items

- Continue to meet, as necessary, with DEP, DAR and other agencies to enforce compliance with existing environmental regulations.
- Review DEP Enforcement protocol.
- Continue to monitor cases through EQ and WsPA tracking system.
- Continue to screen for potential violations through ongoing water quality monitoring, environmental quality assessments, and field surveillance.



5.3 Environmental Quality Assessments

Accomplishments:

- Replaced historic general inventory of threats with detailed subbasin-level, Environmental Quality Assessments (EQAs). Published two assessments, Reservoir and Thomas Basin Districts, and a third, Quinapoxet, will be completed by the end of 2003.
- Compiled all recommendations from Reservoir and Thomas Basin Districts EQAs and initiated implementation recommendations.
- Implemented use of updated databases to track ongoing activity in the watershed
- Initiated in-depth studies on four subbasins with historically elevated fecal coliform bacteria concentrations.

Assessment:

The details provided by the Bureau's EQAs help identify water quality problems, link those problems to the sources of contamination, and develop specific, prioritized goals for corrective actions. EQAs provide a tool to track the impacts of septic systems on a sub-watershed basis.

Key Actions:

- Maintain five-year cycle/rotation for completion of Environmental Quality Assessments based upon the following order.
 1. Publish Quinapoxet EQA.
 2. Complete Stillwater EQA
 3. Complete Worcester EQA.
 4. Update Reservoir EQA.
 5. Update Thomas Basin EQA.
- Continue to conduct in-depth studies on subbasins with complex water quality problems.
- Produce annual status report on all recommendations in past EQAs.

Background

BWM established an ongoing sanitary survey program within the watershed in 1988 to address existing and potential threats to water quality, and to ascertain compliance with state regulations. The Wachusett Reservoir watershed was subdivided into sanitary districts for the purpose of scheduling the completion of sanitary surveys on a rotating three-year basis, and three reports were completed in the early 1990s.

Current Program and Accomplishments

The Wachusett Reservoir watershed was realigned in 1998 into five sanitary districts: Reservoir, Thomas Basin, Quinapoxet, Stillwater, and Worcester. Reports are now generated annually on a five-year rotating basis with a goal of completing one district per year. It was recognized that previous sanitary surveys, while useful, were fairly general both in their inventory of resources and in their identification of specific threats and corrective measures. In order to improve the effectiveness of watershed protection efforts, it was decided to refine the process and complete a much more detailed inventory and assessment of each district at the subbasin level. A total of 49 subbasins were identified within the five Wachusett Reservoir districts, many with years of tributary-specific water quality data. The DEP requires an annual sanitary survey of the entire watershed; to

avoid confusion, it was decided to refer to each of these reports as District Environmental Quality Assessments (EQA). The Reservoir and Thomas Basin EQAs have been published and the Quinapoxet EQA will be completed by the end of 2003.

Completion of an environmental quality assessment is only the first step. Once specific threats have been identified and recommendations for remediation developed, it is necessary for action to take place. A detailed list of all recommendations from the first two EQAs has been produced and priorities established; work is underway on many of these recommendations and a number have been completed. These recommendations include additional water quality sampling in problem subbasins, modification of BWM maps to reflect field verified hydrology, stormwater improvements on state highways and BWM properties, continued cooperation with local boards of health to remediate inadequate septic systems, and additional inspections of agricultural, commercial, and industrial sites. Many of these recommendations are described in relevant sections of this update.

Water quality from Beaman Pond Brook has historically been among the worst in the Wachusett Reservoir watershed. A focused sampling program was initiated following completion of the Reservoir EQA, combining a new understanding of potential threats and updated hydrology. Similar investigations have begun in the Boylston Brook, Oakdale Brook, and Malagasco Brook subbasins.

A database of all incident responses and field investigations now exists and is kept current. Each file is associated with a specific subbasin. Minutes from local boards of health, conservation commissions, and planning boards are obtained each month and relevant information on new growth or septic system problems is documented. BWM has obtained digital copies of town board of health records where available and is able to update these using board of health minutes, which in turn enables the Bureau to locate problem areas and helps focus remediation efforts. Summary water quality data are maintained in a single spreadsheet to help track trends and identify problems.

Assessment

The detailed Environmental Quality Assessment subbasin approach was adopted by BWM to more easily identify and relate observed water quality problems with sources of contamination in the tributaries of the Wachusett Reservoir. These assessments provide a thorough analysis of the health of each individual subbasin, allowing BWM to define specific goals for maintaining and improving water quality in each basin area.

The goals of this program are currently being met. A focused identification of threats and prioritized listing of corrective actions has led to more effective follow-through and resolution of significant problems in the watershed.

Control Approach

Goals

- To provide a comprehensive inventory of resources as well as an overview of existing and potential threats to the water supply.
- To provide a framework for prioritization of remediation and protection activities within the watershed.

Objectives

- Complete detailed assessments of subbasins on a five-year cycle in order to identify potential water quality problems, seek out sources of the problems, and identify options for remediation.
- Utilize the greater level of detail provided by EQA, which replaces the more generalized watershed-wide approach, for a more focused approach to threat identification.

Action Items

- Maintain five-year cycle/rotation for completion of Environmental Quality Assessments based upon the following order:
 1. Publish Quinapoxet EQA.
 2. Complete Stillwater EQA
 3. Complete Worcester EQA.
 4. Update Reservoir EQA.
 5. Update Thomas Basin EQA.
- Implement recommendations for completed EQAs.
- Produce annual status report on all recommendations in past EQAs.

6 Pollution Control

The major goal of the Bureau of Watershed Management is to minimize the impacts of humans and animals on water quality. Section 4 detailed the methods the Bureau utilizes on its own property, the most critical lands in the watershed for the water supply. Section 5 presented the various means used by BWM to monitor water quality. This section details the most significant pollution threats caused by people's presence in the watershed.

The Wachusett Reservoir watershed does not have "point" sources of pollution; i.e., there are no industrial or municipal pipes discharging effluent into any of the reservoir's tributaries. The remaining sources of potential pollution fall into the "non-point source" category. These threats do not emanate from a single location, but are present from various land uses and activities throughout the watershed.

The treatment of wastewater, whether by on-site septic systems or carried off-site through a sewerage system, is a critical component to water quality health. Significant resources have been expended to successfully control this pollution threat. The conveyance of a broader range of potential pollutants via stormwater has subsequently become a higher priority for the Bureau. On-going efforts remain to address site specific threats from transportation and hazardous materials. While agriculture and silviculture are still actively practiced in the watershed, these occupations are not nearly as prevalent as in the past; the Bureau has developed several approaches to minimize the impacts of these diminishing land uses.

6.1 *Wastewater Disposal*

On-site wastewater disposal systems have been considered by BWM for many years to be the most significant potential source of pathogens and other pollutants of concern within the Wachusett Reservoir watershed. Wastewater was targeted as a top priority at the time of the Division's formation in 1985 when the majority of the watershed was served by on-site systems. Many areas within the watershed had significant problems with failing on-site systems, and very limited repair options due to physical constraints. MDC began to take an active role in both on-site system and sewerage issues. A Facilities Plan was completed in 1995 for West Boylston and Holden that described a plan to bring sewers to those areas of the communities where system repairs were not feasible. The Facilities Plan also contained recommendations for areas that would continue to be served by on-site wastewater disposal systems.

The MDC program specifically targeted sewers for sensitive areas that were most impacted by failing on-site systems, had significant physical constraints limiting repairs, and where water resources were potentially impacted by failing systems. The sewage flows to the Upper Blackstone Water Pollution Abatement District, which discharges the treated effluent outside of the watershed. With the completion of the sewer project in 2004, 11,000 persons, or 40% of the watershed residents will have an available sewer system. The remaining 60% of the watershed, or approximately 17,000 persons, will utilize on-site systems.

6.1.1 Sewers

Accomplishments:

- Completed 80% of the sewer construction project, in cooperation with the Towns of Holden and West Boylston. This construction has taken place in the watershed's areas of greatest need for sanitary remediation due to poor performance and density of on-site septic systems.
- Reconstructed Route 70 sanitary sewers in Clinton.
- Drafted model Wastewater Management District legislation.
- Negotiated, executed and implemented updated sewer use agreements between Holden, West Boylston and the MDC.

Assessment:

Upon completion of the \$80 million sewer construction project, 85% of the built or buildable areas of Holden and West Boylston – the areas of the watershed where on-site wastewater systems most impacted water quality – will not use on-site septic systems.

Key Actions:

- Complete the Holden-West Boylston sewer project in 2004.
- Design and implement monitoring program for sewer connections.
- Administer Holden and West Boylston sewer use agreements.
- Implement Worcester sewer system improvements.
- Review Infiltration/Inflow reduction and monitoring issues between the city of Worcester, the Upper Blackstone Water Pollution Abatement District, and the towns of Holden, West Boylston and Rutland.

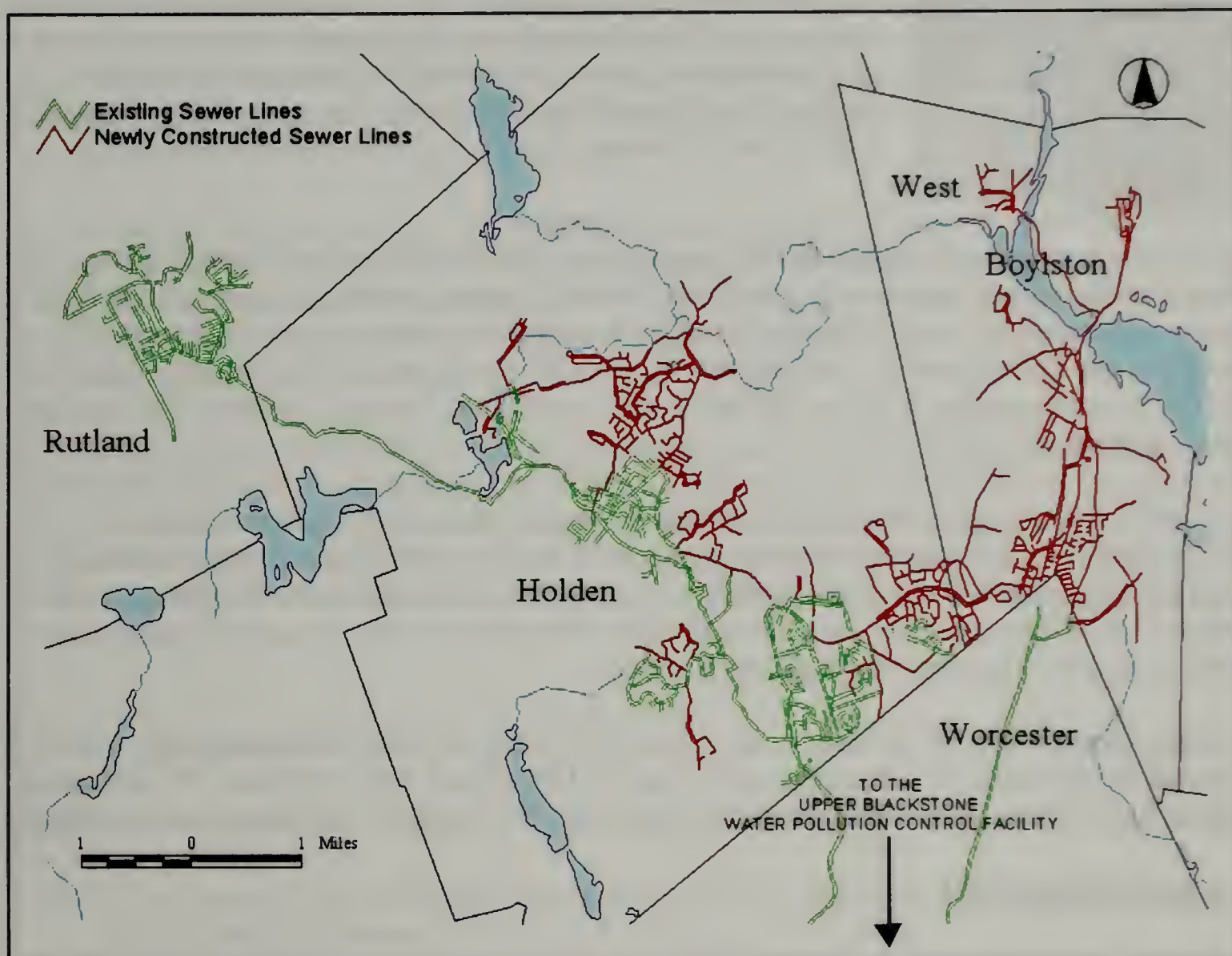
Background

The installation of sewers by the BWM in the Wachusett Reservoir watershed in order to help solve water quality issues was initially undertaken in the 1930s. The construction of the Rutland-Holden sewer line, authorized under c. 375 of the Acts of 1927 and c. 262 of the Acts of 1932, introduced sewer service to the region. Chapters 286 and 287 of the Acts of 1939 turned over the local sewer systems to the respective towns, but also required MDC (and subsequently MWRA) to continue to own, operate and maintain the Rutland-Holden Interceptor on behalf of those towns as well as to contract with Worcester for sewage transportation and treatment in that city's system.

The DWM evaluated several densely developed areas in Holden and West Boylston in 1993 that had soil conditions unfavorable for on-site septic systems and sanitary problems identified by Division water quality data. Following this study, the DWM and the towns of West Boylston and Holden completed a Wastewater Facilities Plan in 1995 that addressed the towns' sewer needs. The resulting Facilities Plan set out a program for phased construction of sewers to serve the areas of greatest need, based on a range of criteria including poor performance, water quality impact potential, and building density.

The areas to be sewered included the West Boylston industrial area, Pinecroft neighborhood, and the developed business and residential areas along Route 122A and Route 31 in Holden and along Route 12 in West Boylston. These areas are within West Boylston Brook, Gates Brook, Oakdale, Chaffin Pond and Lower Chaffin Pond, and Asnebumskit subbasins. These subbasins were found to have

Figure 6-1: Sewered Areas of Wachusett Reservoir Watershed



stream water quality most impacted by septic systems in several studies conducted by the Division (see Figure 6-1).

Current Program and Accomplishments

After several years of extensive negotiation and legislative activity, a financing program was enacted providing initially almost \$60 million to complete sewer system design and construction. Two supplemental budget amendments raised the total budget to \$78 million to incorporate among other things:

- \$66 million for sewer design and construction.
- Low-interest loans to property owners to finance installation of service connections.
- \$2.6 million for payment of membership costs for Holden, Rutland and West Boylston to become members of the Upper Blackstone Water Pollution Abatement District.
- \$1 million for Infiltration/Inflow removal from the Holden sewer system.
- \$600,000 for initial management start-up costs for West Boylston.
- \$2.3 million for improvements to the Worcester sewer system.



Sewer construction.

The majority of this funding – \$53.6 million, or 69% – was bonded by the Commonwealth through the MDC. The MWRA has contributed \$9 million, or 11% of the total cost. The two towns combined to pay 20% of the project; \$8.1 million for West Boylston and \$7.4 million for Holden. The towns utilized low-interest loans available through the DEP's State Revolving Fund for infrastructure development.

The project was designed and constructed in phases. Phase I included Fast-Track design and construction of two sewer service areas. The West Boylston Industrial area was completed in 1998. The Pincroft area in Holden and West Boylston was completed in 2000, with conveyance of the completed portions of the systems to the respective towns for operation and maintenance. Phase II included design of all remaining sewers (Phase III and Final Phase). Designs for Phases III and Final Phase were completed in 2001.

Phase III included two major construction contracts in West Boylston and three construction contracts in Holden. All gravity sewer and force mains in the Phase III contracts are complete and all of the Phase III sewer system components have been turned over to the towns for operation and maintenance. As of June 30, 2003 approximately 50% of the sewer service connections have been completed in the Fast Track and Phase III service areas.

Finally, improvements need to be made to the City of Worcester's sewer system in order to accommodate the hydraulic flow from the new sewers in Holden and West Boylston. Work totaling \$2.3 million will be done at locations on Cambridge St. and Newton Sq. to remediate these problems.

Inflow and Infiltration (I/I)

Cracks, settling, tree root intrusion, and other disturbances that develop over time deteriorate pipe lines and other conveyance structures that comprise wastewater collection systems. These deteriorating conditions can increase the amount of inflow and infiltration (I/I) entering the system, especially during periods of wet weather. I/I is clean storm and/or groundwater that enters the sewer system through cracked pipes, leaky manholes, or improperly connected storm drains, down spouts and sump pumps. Most inflow comes from stormwater and most infiltration comes from groundwater.

Increased I/I levels create an additional hydraulic load on the system and thereby decrease its overall capacity. I/I levels also have an impact on maintenance and treatment costs. All sewer lines in the Wachusett Reservoir watershed towns of Holden, Rutland and West Boylston are connected through the City of Worcester's sewer system to the Upper Blackstone Water Pollution Abatement District Treatment Plant in Millbury; the towns have contracts with the District regarding the amount of sewage that can be treated. Control of I/I issues is crucial to maintaining the capacity of both the sewer lines and the treatment plant.

Assessment

BWM has spent considerable effort to bring sewers to the areas that were severely septic polluted. The completion of the Wastewater Facilities Plan for the Towns of Holden and West Boylston, and

the approval of a funding program totaling \$78 million, is a very significant accomplishment. It is estimated that, upon completion of construction in 2004, 40% of the approximately 10,000 on-site wastewater disposal systems in the watershed will be connected to the sewer system. The new sewer system coverage in Holden and West Boylston coincides with subwatersheds most severely impacted by on-site wastewater disposal based on BWM's septic severity rating system stream classifications.

Approximately 2,200 watershed residents in Holden and Rutland already are connected to sewers built by MDC in the 1930s. Based on the on-going sewer system expansion in Holden and West Boylston, an additional 3,600 lots will connect to sewers. The Bureau will track the hook-ups to the sewers in order to help maximize the number of homes within the service areas that are connected to the sewers as they become available.

There are currently an estimated 10,200 on-site systems serving an unsewered population of about 28,000 within the Wachusett Reservoir watershed. After completion of the sewers, approximately 60% of watershed residents will remain served by an estimated 6,600 on-site systems. The completion of the municipal sewer systems currently under construction will enable BWM to focus wastewater efforts on the remaining moderately impacted acres and the areas less impacted by wastewater.

Control Approach

Goals

- To protect existing high-quality water resources from degradation due to wastewater disposal in the watershed system.
- To minimize through education and outreach the potential impacts of wastewater disposal on the waters of the watershed system.

Objectives

- Complete construction of the Holden-West Boylston Sewer Project on schedule.
- Assess impacts of the eliminated septic systems on tributary water quality.

Action Items

- Complete Final Phases of sewer project in Holden and West Boylston.
- Track connections to new sewer lines.
- Implement Worcester sewer system improvements.
- In conjunction with routine water quality monitoring, assess impact of sewers on water quality, and prepare periodic reports.
- Assist Rutland and Holden with Infiltration/Inflow (I/I) Reduction Programs.
- Evaluate I/I and sewer condition of BWM Rutland-Holden trunk sewer.

6.1.2 On-site Treatment

Accomplishments:

- Innovative systems piloted for existing homes in areas that are not in sewer service area and cannot accommodate Title 5 system.
- Septic system information from watershed towns collected and entered in electronic database system

Assessment:

Existing environmental regulations for on-site wastewater disposal are adequate to ensure water supply protection.

Key Actions:

- Continue water quality monitoring program and Environmental Quality Assessments to monitor for impacts from problem systems.
- Work with local Boards of Health and the DEP to see that Title 5 is strictly enforced in watershed communities.

Background

The principal body of regulations governing the design, installation, operation, and maintenance of on-site wastewater disposal systems in Massachusetts is Title 5, codified at 310 CMR 15.000. Title 5 is promulgated and administered by DEP and at the local level by the boards of health (BOH).

Under the current institutional and legislative arrangements governing on-site systems, BWM has focused its resources on:

- Identifying problem areas (using water quality monitoring and Environmental Quality Assessment data (see Section 5).
- Referring enforcement issues to the appropriate BOH and/or DEP office.
- Providing technical assistance to BOHs and property owners.
- Prioritizing areas in need of facilities planning and sewer construction, as with the Holden-West Boylston Sewer Project (see Section 6.1.1).

Current Program and Accomplishments

The 1991 Plan and 1998 Update identified a range of measures to be undertaken concerning on-site septic systems, such as:

- Provide technical assistance to BOHs to repair and/or replace failing systems and ensure strict enforcement of Title 5.
- Develop model BOH regulations.
- Limit density of new on-site systems through the WsPA.
- Provide information on septic system maintenance to BOHs and homeowners.

The Bureau has made substantial progress on each of its objectives. BWM put significant effort into establishing effective working relationships with local BOHs and initiating an evaluation of

alternative institutional mechanisms for management of on-site systems. MDC also completed three projects to assist watershed communities with on-site waste-water disposal.

MDC conducted a legal and technical analysis to identify alternative approaches for local wastewater management districts. A district approach could yield considerable benefits to BOHs and individual property owners, ensuring maintenance, inspection, pumping, repair or replacement, and system upgrades. A product of this effort was a framework for a legislative petition to create a wastewater management district that could be established on a regional, town wide, or neighborhood scale. This template is available for implementation by the watershed communities.

MDC funded the design and installation of five on-site systems using alternative technologies to demonstrate the systems' applicability, reliability and cost efficiency. The systems installed included FAST system, Waterloo Biofilter, Jet aerobic, Jet aerobic and sand filter, recirculating sand filter, and intermittent sand filter. The systems, installed in 2000, are currently being evaluated.

MDC identified the need for better and more accessible information on septic systems. DWM worked with the watershed BOHs to enter information into an electronic database. DWM engaged the services of a consulting firm to identify a suitable database program, inventory local parcel data from town records (including the BOH and Assessors offices), create a database for each town, link the parcel information to the BWM GIS system database, and install the program and provide training to town and BWM personnel.

Assessment

On-site wastewater disposal can be an accepted method of wastewater disposal in a water supply watershed, provided that such systems are designed, operated, and maintained in compliance with the Title 5 requirements, and that water quality is not impaired. Within those portions of the watershed expected to continue using on-site systems, there are a few individual lot and isolated neighborhood trouble spots. The BWM will address any potential problems on a case-by-case basis with the local boards of health.

Most on-site septic system issues are sufficiently controlled by Title 5. The 1995 revisions to Title 5 represented a major improvement to regulating on-site systems. In cases of a significant failure (e.g., surficial failure or obvious water quality impact), Title 5 has provisions for immediate action and enforcement. Title 5 also allows for the use of alternative technologies in cases where, due to lot size or soil conditions, individual lots cannot replace a problem system with a conventional system in conformance with Title 5. Title 5 also addresses less obvious or visible problems with existing systems by requiring inspections and system repairs with property transfers. Finally, both Title 5 and the WsPA prevent the construction of new on-site systems in sensitive areas (e.g., within 200' of a tributary to a water supply).

Property owners, town boards, DEP, and BWM each have a role in the proper control of wastewater in the watershed. Together, these entities are responsible for implementing several elements of a comprehensive, watershed-based approach to on-site wastewater management (see **Table 6-1**).

Table 6-1
Responsibilities in On-Site System Management

Management Issue	BWM	DEP	BOH	Property Owner
Monitoring & Identifying of Problem Systems	✓		✓	
Title 5 Administration		✓	✓	
On-Site System Operation & Maintenance				✓
On-Site System Repair & Replacement				✓
Septage Disposal & Accounting			✓	✓
Record-keeping & Reporting			✓	
Enforcement		✓	✓	
Public Education	✓	✓	✓	

Source: DCR/DWSP/BWM

The experience gained by BWM over the past ten years through its working relationships with DEP and the watershed towns' boards of health serve as a good foundation for continued success in dealing with an issue of continuing concern in the Wachusett Reservoir watershed. The Pilot On-site Remediation Program has installed alternative septic technologies in the watershed to encourage, by example and assessment, the use of these and similar systems to remediate sites where conventional septic repairs have been difficult or impossible to facilitate. Educational material on the application and operation of innovative systems in soil conditions typically found in Wachusett Reservoir watershed will be developed as staffing resources permit and operational and monitoring data become available over the next few years. The On-Site Wastewater Management District study provides a framework for an alternative approach to maintenance, inspection, repair, and replacement of septic systems in the watershed.

The septic database project has computerized available septic systems records in the watershed communities. This effort provided useful information on areas where high groundwater, poor soils, frequent pumping, and failing septic systems point to needed remediation. Each local board of health will decide whether to utilize the system and keep their town's records up-to-date.

Control Approach

Goals

- To protect water resources from degradation due to on-site wastewater disposal in the watershed.

Objectives

- Identify potential problems with on-site wastewater disposal.
- Work with local Boards of Health and DEP to resolve any problem sites.
- Ensure that on-site systems in the sewer service areas are connected in a timely manner.

Action Items

- Continue to review routine water quality data for any evidence of potential problems with on-site systems.
- Review local records, water quality data, and other pertinent information in conducting Environmental Quality Assessments to identify potential problem sites or areas.
- Provide assistance, as requested, to local boards of health on wastewater disposal issues, such as alternative technologies, septic system Operation & Maintenance, and local and regional management alternatives.
- Continue to monitor Alternative/Innovative systems installed in BWM pilot program.
- Utilize Septic Database System to develop statistics based on subbasin, type of system and age, as well as information pertaining to problems, repairs and Title 5 replacements.

6.2 Stormwater Management

Accomplishments:

- Implemented BMPs at critical sites around the reservoir.
- Supported non-structural initiatives, including advising local officials, coordination with DEP on Stormwater Advisory Committee, and attendance at public workshops on Phase II regulations.
- Awarded a contract to Town of Holden to develop stormwater management regulations.
- Conducted stormwater quality monitoring to quantify stormwater pollutant concentrations and loads.

Assessment:

BWM has made significant progress dealing with a number of specific water quality threats, such as failing septic systems, potential releases of hazardous materials, and wildlife. As a result, stormwater, which can be considered a general category that encompasses all land-use generated pollutants, has become a high staff priority. Federal NPDES Phase II stormwater requirements have been established since the 1998 Plan was developed, and will provide an opportunity for a coordinated approach to address stormwater impacts.

Key Actions:

- Work with local towns to assist in preparing and planning for the required Phase II Pollution Prevention Plan and other stormwater management issues.
- Identify, design, and construct key structural BMPs on BWM property.
- Continue to work with the Massachusetts Highway Department and local highway departments to implement stormwater improvements when conducting projects under their control.

Background

Stormwater pollution is generated from two general sources, Point and Non-point sources; each poses different challenges to water quality protection. Point sources are discrete discharges of processed water that directly flow to a point through a conduit; there are no Point source discharges to the Wachusett Reservoir. Non-point sources of stormwater pollution are caused by the daily activities of people and animals in the watershed. Rainwater and snowmelt that contacts developed areas, roadways, lawns, farms, and construction/industrial sites can pick up pollutants that are carried to the reservoir.

Stormwater runoff is one of the most common causes of water pollution. Stormwater pollution is caused by so many different activities that traditional, "end-of-pipe" regulatory controls have limited effect. In order to minimize stormwater's impact, there needs to be a clear definition of the pollutants of concern, the sources of these pollutants, and the available mechanisms to reduce the pollutants. Structural facilities and non-structural practices (operations and management) are the general categories of these available mechanisms, with education and outreach as key components to a successful watershed-wide stormwater program.

Sediment, excess nutrients, bacteria and pathogens (from human and/or animal sources), debris, hazardous wastes, thermal pollution, heavy metals, and road salts are the general list of typical pollutants of concern. The characteristics of each pollutant and the resource being protected is considered when assessing the relative importance or threat of these pollutants.

Natural landscapes allow rainfall and snowmelt to percolate into the soil, where it is used and slowed by the vegetation. When natural landscapes are developed, the density of the vegetation is reduced and the amount of impervious area increases, which causes increased stormwater runoff. In a natural woodland area, approximately 50 percent of rainfall will infiltrate into the soil and 10 percent will travel as runoff. In a densely developed landscape (80 percent impervious) the amount of infiltration is reduced to 15 percent, while the amount of runoff increases to 55 percent (DEP, 1997). When new construction is being planned, stormwater controls can be incorporated into the design to reduce the impact of the development, but in already built areas, implementing stormwater controls can only be retrofitted on a very limited basis into the existing landscape. The most visible example of water pollution is the discolored runoff from construction sites. A thousand times more sediment can be transported from a stripped construction area than from the same area when it was a woodland or meadow.

Further harm can be derived from the practice of piping the stormwater flow to a stream without treatment, which causes erosion of the natural stream channels. The volume of runoff from developed areas can be up five times greater than before the development occurred; this runoff has historically been piped directly to the streams. Stream channels are formed based on the flow characteristics of the storms that occur most frequently. Referred to as "bank-full condition", this situation occurs in the Wachusett Reservoir watershed at approximately two and a half inches of rain in a 24 hour period. Less frequent, larger storms overflow the banks and are carried in the flood plain of the stream. The frequency increases for the stream to be subjected to flows that exceed the bank-full conditions when development occurs. In these situations, the vegetation along the streams is unable to withstand the erosive forces and the banks begin to erode. Once the vegetation along the

banks is removed, then the released sediment and nutrients turns the stream itself into a source of pollution.

Previous Watershed Protection Plans, in addition to addressing stormwater itself as a pollutant source, have included programs to respond to pollution sources that are subsequently transported to the reservoir in stormwater, such as failing septic systems, wildlife, and construction activities. Some of the strategies discussed in this section overlap with programs and activities discussed in other sections of this plan.

Current Program and Accomplishments

During the development of the 1998 WPP Update, Camp, Dresser and McKee completed the *Wachusett Watershed Stormwater Management Project* for the MDC. This project developed a comprehensive approach for the control and management of stormwater as a non-point source of pollution within the Wachusett Reservoir watershed. The project followed the BWM's three water quality objectives:

1. For subbasins with no known water quality problems, provide protection to insure no degradation.
2. For subbasins where water quality has been degraded, provide remediation to improve the water quality entering the reservoir.
3. Institute measures for prevention in advance of proposed development.

To prioritize the implementation and to optimize the proposed treatments to meet these objectives, the project modeled the subbasins using existing water quality data for particular pollutants of concern associated with stormwater (e.g., bacteria and nutrients). The Stormwater Management Project provided a collection of activities and Best Management Practices (BMPs), ranging from broad watershed wide non-structural practices to site specific structural activities. Many of these were incorporated into the 1998 Plan Update and its' five year Action Plan.

The parameters used to calculate estimates of the travel times throughout the Wachusett Watershed were calibrated in field tests by CDM in order to produce a map of the worst-case travel times to the reservoir. Two maps were completed, modeling travel time to the reservoir using wet season and dry season stream base flow conditions. The modeling was done assuming that a spill on land would contain enough volume to flow to a stream from anywhere in the watershed. Detention time within ponds and swamps was not included.

Many of the recommendations of this project have been completed and evaluated in the intervening period. Additional information collected during the Environmental Quality Assessments has helped prioritize these activities. Emphasis has been placed on stormwater sampling in order to provide clarification of pollution threats and the extent of these threats to the reservoir. Bureau staff initiated specific stormwater sampling to assess distinct concerns and also increased sampling during storm events through a cooperative program with the University of Massachusetts, Amherst.

Review of these data has reinforced earlier work pointing to the importance of stormwater relative to total pollutant loadings to the reservoir. An example of the changes in pollutant concentration in a stream during and following a stormwater event is shown in **Figure 6-2**. Phosphorus concentration

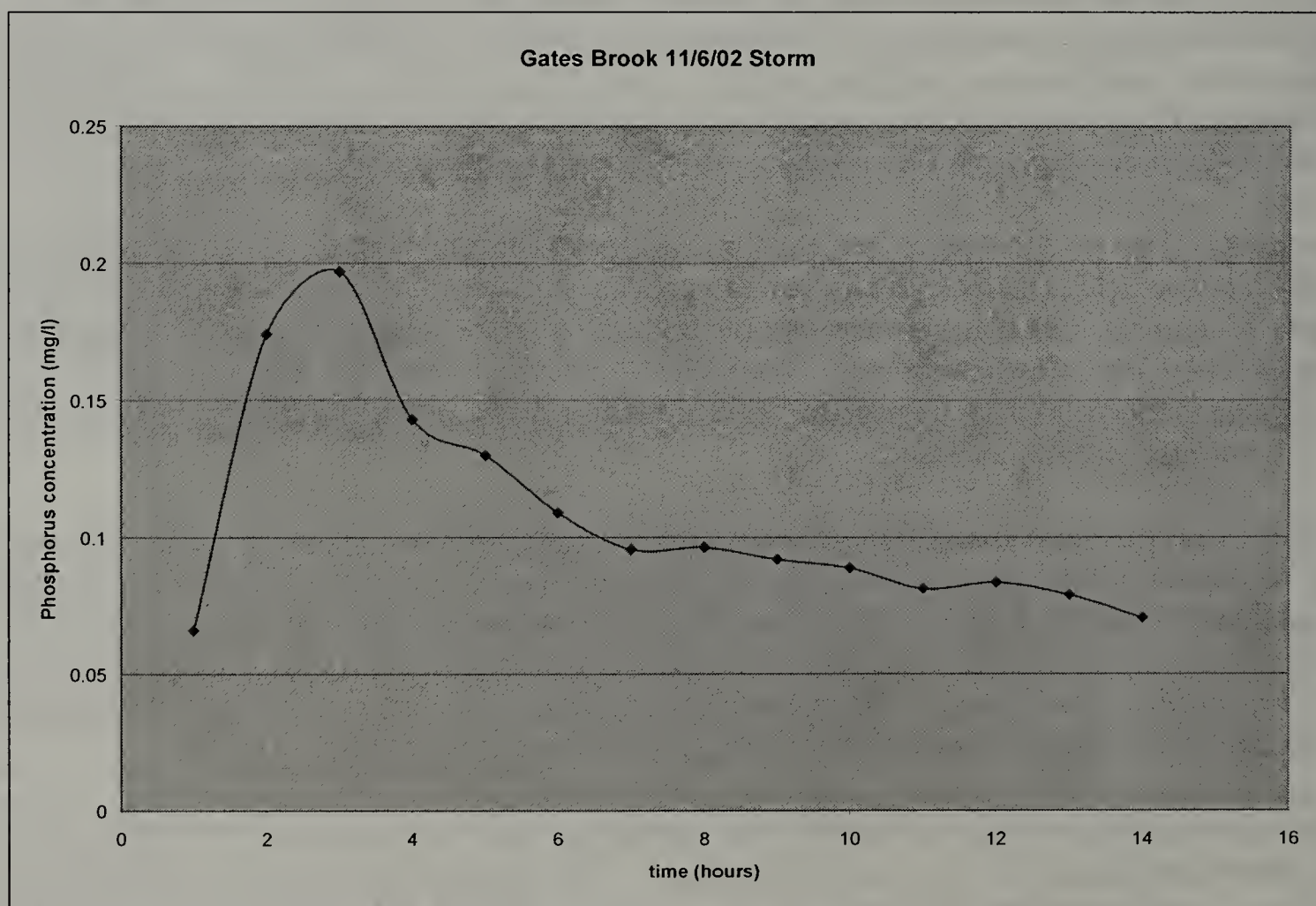
was measured in Gates Brook and is plotted over time using zero hour as the beginning of the rainfall. The graph illustrates a high concentration of phosphorus carried in the stream during a storm event.

A "Stormwater Project List," as described in the 1998 Plan, was developed and has been updated to be used to inventory and prioritize projects recommended to remediate stormwater and improve safety and spill containment for highways and railways (see **Section 6.3**). Several Massachusetts Highway Department projects have been reviewed and monitored, including:

- Resurfacing of Interstate 190.
- Reconstructing the intersection of Route 140 and Dana Hill Road.
- Renovating two bridges along Route 140 in Princeton.
- Replacing culverts and drainage discharge piping throughout the watershed.
- Designing replacement bridges for the Stillwater River crossing on Muddy Pond Road in Sterling and the Quinapoxet River crossing of Mill Street in Holden.

Construction of stormwater controls in the area of the Cosgrove Intake are being implemented by MWRA in the fall of 2003, including the redirection of highway drainage from directly discharging to the Carville Basin to outside the watershed. The application of stormwater control BMPs at sites around the reservoir were planned and preliminary designs have been completed for the areas adjacent to the reservoir along Routes 140, 110, and 12 in Boylston, West Boylston, and Sterling.

Figure 6-2: Phosphorus Concentrations During A Storm Event



Source: DCR/DWSP/Wachusett EQ

Although staffing and budget limitations prevented the completion of the drainage structure mapping project identified in the 1998 Plan, many outlets and major hydrologic features were inspected and inventoried in the districts closest to the reservoir as part of the Environmental Quality Assessments (see Section 5.3). The Bureau intends to complete this mapping project using in-house capabilities.

Staff tracked and contributed to DEP's stormwater management projects through the DEP Stormwater Advisory Group. This group prepared a set of Model Bylaws and a Guidance Document to assist local communities with compliance with EPA Phase II requirements. The model presents the framework for bylaws to address Illicit Discharges, Construction Phase Erosion and Sediment Control, and Operation and Maintenance.

The Bureau has worked directly with the Town of Holden on stormwater issues. The Bureau awarded a Technical Assistance Contract in 2002 to the Town of Holden to create a set of "Unified Stormwater Management Regulations" (see Section 8.1). Holden intends that this project will help alleviate conflicting requirements between federal, state, and municipal regulations, and reduce excessive and differing standards for reviews between the board of health, planning board, and the conservation commission. The goal of this work is to produce a set of regulations that will clearly and effectively assure that development is conducted in a manner that will control stormwater flow rate and volume, and minimize degradation of water quality, and insure conformance with EPA Phase II requirements. This project is scheduled for completion by June 2004, and will also be available to be utilized as a model for other communities.

Filter Curtain Pilot Project

A major accomplishment was the completion of a pilot project involving the installation and monitoring of a filter curtain at Malagasco Brook Cove. This pilot project, partially funded through a grant from the EPA's National Risk Management Research Laboratory to assess innovative technologies, consisted of both a bench-scale and full-scale deployment of a Gunderboom Reservoir Particulate Control System (RPS™), developed by Gunderboom, Inc. The bench-scale component of the study was conducted by Wright-Pierce Engineers of Topsham, Maine, while the full-scale deployment was conducted at Malagasco Brook Cove in the Wachusett Reservoir. Each scale involved sampling and analysis during six different storm events.

The results of both the bench-scale and full-scale demonstration studies revealed that the filter curtain can effectively capture and retain the pollutants tested under various flow conditions that are within the filter curtain's design limitations. The filter curtain functions much like a detention basin in that the rate of inflow is considerably slowed down, allowing for increased settling of suspended particles within the enclosed area. An example of the results show the average reductions for fecal coliform bacteria were substantial, ranging from 78 to 98 percent in five out of six events that had valid data. The findings of this study indicated that use of the filter curtain technology could be an effective tool to protect the water quality in surface water resources, especially when combined with other storm water treatment devices used throughout the watershed. Long-term operations and maintenance costs have to be determined prior to considering installation at other suitable locations.



Filter curtain deployed at Malagasco Brook Cove.

Assessment

BWM has made significant progress dealing with land use and other activities that were the greatest concern to water quality in previous watershed plans. For this reason, stormwater management has been assigned a higher priority for staff resources. This promotion reflects BWM commitment to devote greater resources to the threats posed by stormwater, and does not indicate an increase in pollutants from stormwater.

Bureau concerns for structural controls focus on untreated direct discharges to the Reservoir, I-190 stormwater facility maintenance, and installation of site specific BMPs at selected sites in the watershed. Non-structural strategies to control stormwater impacts focus on coordination with municipalities. The revisions to the NPDES permitting (EPA Stormwater Phase II) has focused responsibility for coordination of control of stormwater pollution to towns and forces development of Stormwater Management Plans for the larger watershed communities. The coordination between the BWM and Mass Highway Department has greatly improved; most projects are currently informally presented to the Bureau at the early design stage, and the comments are incorporated into the designs, when possible. The MHD is also subject to the NPDES Phase II stormwater rules; this forum may be a useful tool to assist implementation of BMPs on MHD-controlled roadways.

The Bureau has developed a three tier approach to managing stormwater concerns focusing on protection, remediation, and prevention. The stormwater control work that has been conducted has demonstrated that effective, fiscally responsible initiatives must be implemented for specific pollutants that are causing documented problems within the reservoir. Successful implementation should focus on the following elements:

- **Public Education, Local Coordination and Technical Assistance:** Apply the proven water quality protection strategy of watershed-wide BMPs. Take advantage of opportunities provided by the revisions to the NPDES Phase II to enhance stormwater protection and monitoring by working with the applicable communities.
- **Studies and Investigations:** Collect and analyze data that are critical to the formation of effective stormwater control strategies. Topics to study can range from generalized water quality stormwater threats to specific pollutants and areas of concern.
- **Best Management Practices:** Design, permit and install structural BMPs on BWM-owned lands which are located by studies that assess optimal water quality protection benefits.

Control Approach

Goals

- To enhance the water quality reaching the reservoir through BWM-owned property.
- To assist local and state officials in taking responsibility for improving quality of local stormwater runoff.

Objectives

- Work with Mass Highway Department and local highway departments to improve water quality from road runoff.
- Support local measures that address stormwater and optimize opportunities to work with communities on stormwater management and planning.
- Continue research, and initiate appropriate new studies, to improve specificity in pollution control.
- Continue and refine stormwater sampling program and modeling efforts.
- Continue to install structural BMPs on BWM land.
- Integrate stormwater control efforts with other elements of the Watershed Protection Plan, including: Construction (Erosion and Sedimentation Control), Technical Assistance, Public Education and Community Outreach, and Research Projects and Special Studies.

Action Items

- Add additional stormwater sampling. Continue work with UMass to collect stormwater samples after hours.
- Add additional stormwater sampling specific sites to evaluate BMPs (before and after installation).
- Assess research needs relative to stormwater modeling and monitoring.
- Review MHD Phase II permit and meet to coordinate with appropriate MHD staff.
- Work with MHD specifically on I-190 basin maintenance.
- Work with local towns to assist in implementing the required Phase II Stormwater Management Plans.
- Provide technical assistance to towns, as requested, on issues such as stormwater bylaws.
- Develop revised list of projects for the 2004 – 2009 timeline that integrates water quality and resource considerations. Install one new BMP each year for next five years.
- Complete stormwater mapping for major conveyance structures in the watershed.

6.3 Transportation and Hazardous Materials

The Wachusett Reservoir watershed is not a remote, isolated area. Thousands of people live in the watershed; roads and railroads traverse the region and are significant watershed features. The impacts from daily transportation activities on water quality must be managed by the Bureau. The Bureau must be prepared to respond to accidents that might release hazardous materials or other pollutants into the reservoir. In light of heightened security concerns, the Bureau must also consider the possibility of deliberate releases and develop preparedness plans.

The strategies discussed here overlap with and are coordinated with activities discussed in the sections on stormwater and security (**see Sections 6.2 and 7.2**). The Bureau's goals for transportation related issues are:

- To improve the safety both of roads and railways, thereby decreasing the possibility of accidents occurring.
- To improve drainage structures to detain any materials spilled, and prevent or slow their reaching streams or the reservoir.
- To improve capability of local responders to respond to a spill. This includes providing training and equipment geared to the unique considerations should a major spill occur in the Wachusett Reservoir watershed.

6.3.1 Highways and Railroads

Accomplishments:

- Prioritized and implemented projects to improve operational and structural protection along highways and railways.
- Improved communication and coordination between the Bureau and among operators and regulators of roadways and railways.
- Provided public education materials for water quality risks associated with transportation activities.
- Monitored local and regional projects being conducted within the watershed.
- Designed the Cosgrove Intake/Rt. 70 Stormwater Project.

Assessment:

Transportation related runoff is a moderate threat, though spill/releases are a high potential threat (see Section 6.3.2). The most significant pollutants in runoff are heavy metals and petroleum products; less significant pollutants are sediments and pesticides/herbicides. Reducing the risk of accidents through the careful application of roadway salt was determined to be a significant benefit to the watershed; sodium from winter road run-off is a minor pollutant that does not impact water quality.

Key Actions:

- Coordinate efforts with State and local highway departments to improve operational and maintenance practices.
- Improve existing infrastructure to treat or redirect all direct discharges to the reservoir and incorporate Best Management Practices (BMPs) into new construction and improvements of existing roads.
- Map and monitor stormwater conveyance structures/systems.
- Continue to dialogue and determine management opportunities with the railroads for operational and maintenance improvements.
- Coordinate with active railroad companies on security and freight issues within state and federal guidelines.
- Complete the Cosgrove Intake/Rt. 70 Stormwater Project.

Background

Transportation related threats come from cars, trucks, or rail cars that traverse the approximately 350 miles of roads and 18 miles of railroad in the Wachusett Reservoir watershed. In order to construct Wachusett Reservoir, several roads and a railway were relocated. The relocated railways and

highways are in close proximity to the reservoir, and in some locations actually cross the reservoir, which increases the potential vulnerability of the reservoir to both accidents and daily run-off. Pollution threats from transportation activities include potential release of materials being transported as well as the materials used in the operation of vehicles, such as fuel and associated chemicals. The potential volumes, and thus potential risks, are much greater from release of the former. The BWM has pursued a multi-faceted approach to minimize the pollution threats associated with transportation corridors. This approach includes: identifying sources and transportation routes of Hazardous Materials, educating both transporters and the general public about the risks to the water supply and working cooperatively with local and state agencies on drainage improvements and emergency planning.

Current Program and Accomplishments

MDC engaged the services of the consulting engineering firm Rizzo Associates, Inc. to assist in developing a comprehensive approach to transportation threats. The results of the study, published in *Hazardous Materials Transportation Release Control Project* (Rizzo, 1998), have been used to guide the overall program in the Wachusett Reservoir watershed.

Highways

Roads and bridges in the watershed are owned and maintained by the Massachusetts Highway Department (MHD), local municipalities, and the BWM. MHD controls most of the major highways, although portions of some of the highways may be under local control. BWM has developed a good working relationship with MHD. The Bureau reviews highway projects for impact on watershed resources and offers suggestions and designs for incorporating BMPs to minimize stormwater. In 2001, all guardrails on the MHD roads surrounding the Wachusett Reservoir were replaced with stronger guardrails (see **Figure 6-3**). BWM assisted MHD by developing specifications for this project that could meet MHD and BWM needs. 6,900 feet of reinforced guardrail were installed surrounding the Wachusett Reservoir along Routes 70, 140, 12, and 110. The standard guardrails removed in the process were re-used by BWM to limit access in prohibited areas in the watershed and to replace older guardrail in other areas of the watershed not adjacent to the Reservoir.

Figure 6-3: Example of Guard Rail Replacement



Structural controls have been implemented in key areas to reduce the likelihood of spills reaching the reservoir, and are summarized in Table 6-2.

Railroads

There are two major railroad lines in the Wachusett Reservoir watershed: Providence & Worcester and Guilford Transportation. The most crucial piece of rail line is the 7.5 miles of track owned by Guilford that traverses the western perimeter of the Wachusett Reservoir. BWM has an ongoing dialogue with the railroad companies to ensure that their cargo is safely transported through the watershed. Sharing data on the hazardous materials carried over these tracks is a particularly sensitive issue for the railroad companies. BWM and MWRA have worked with EOEa and the railroad companies to obtain this information in order to be prepared for any potential emergency.

Recent repairs to the railroad bridge over the Stillwater River and adjacent to the Thomas basin is an example of the relationship between the BWM and the railroad companies. BWM inspected this bridge, owned by Guilford Railroad, early in 2002. The Bureau noted a rail misalignment with settling of ballast along the line at the bridge. The area was subsequently inspected by Guilford personnel and the rail was aligned and additional ballast was placed.

The Department of Agricultural Resources administers the Right-of-Way Management Regulations (333 CMR 11.00) that affect the railroad and utility companies. These regulations proscribe setback requirements from drinking water supplies for the application of pesticides. The Pesticide Board, which has authority to enforce this law, has been in the midst of revising these regulations due to requirements set forth in the Commonwealth's May, 2000 "Act to Protect Children and Families From Harmful Pesticides." BWM and MWRA staff have been actively involved in reviewing and commenting on the revised regulations, ensuring the maximum benefit to water quality from this law (also see Section 5.2.3). The railroads Yearly Operating Plan and five-year Vegetation Management Plan are closely scrutinized by BWM to ensure proper setbacks from tributaries in the watershed system.

Assessment

In general, runoff from highways and railways is a low to moderate threat, however an accidental spill or other release of hazardous materials is considered a high potential threat. The most significant pollutants in runoff are heavy metals, petroleum products, and potential chemical contaminants. Less significant are sediment and pesticides/herbicides.

There have been public concerns regarding sodium from roadway de-icing. Elevated sodium is more commonly found in groundwater than surface water. Water quality testing has not shown sodium in Wachusett Reservoir water in detectable concentrations. MWRA also measures sodium monthly in the finished water. The levels are very low and there is no public health risk. It was determined, therefore, that the benefits of road salting in winter conditions – reducing the risk of accidents along the roadways and decreasing the potential for spills caused by accidents – when done in a careful manner, outweighs its impact on water quality.

BWM has built upon the *Transportation Release Controls Study*, working with local communities, MHD and rail carriers on improving drainage infrastructure so that pollutants are removed from stormwater prior to discharge to the reservoir or its tributaries. The drinking water and transportation agencies gain mutual benefits by increasing the safety of highway and railway corridors, which in turn minimize the opportunity for accidental spills. Section 6.3.2 discusses emergency response planning.

Control Approach

Goals

- To make improvements in the safety of the transportation corridors by structural and operational enhancements, minimizing the threat from accidental releases.
- To improve existing drainage infrastructure to minimize pollutants that are discharged with stormwater to the reservoir or its tributaries.

Objectives

- Work with MHD, railroad companies and local communities to improve road drainage, maintenance and safety conditions.

Action Items

- Coordinate efforts with State and local highway departments and railroad companies to improve operational and maintenance practices.
- Advocate for State and local highway departments to include Best Management Practices (BMPs) into new construction or improvements of existing roads in order to treat or redirect all direct discharges to the reservoir.

6.3.2 Hazardous Materials Emergency Planning and Response

Accomplishments:

- Reviewed Federal and State databases of USTs/ASTs, hazardous materials generators, and fixed site and transportation-related spills/releases.
- Established BWM's position and responsibilities within the communication system and incident response efforts with state and local emergency personnel.
- Purchased and established mobile units and supplemented supplies for all communities for HazMat Emergency Response.
- Coordinated with State and local agencies to improve coordination of emergency response planning within watershed.
- Provided Emergency Response training for BWM staff and local fire departments.
- Provided public education materials for health risks associated with accidental hazardous material releases.
- Deployed emergency spill containment equipment at BWM and local fire department sites.

Assessment:

The level of threat from an accident involving hazardous materials depends on the type and volume of the product released, the location of the incident, and weather conditions. The most critical areas are within and adjacent to the reservoir, which also have the highest volume of hazardous material transportation.

Key Actions:

- Refine participants and responsibilities in the Hazardous Materials Emergency Response.
- Support training and equipping of BWM staff and local responders.
- Coordinate drills and communications to maintain and improve cooperation among State and local responders.
- Prepare and maintain plan that prioritizes responses on BWM property, and assist communities with update and preparation of their Comprehensive Emergency Response Plans.
- Coordinate with active railroad companies on security and freight issues within state and federal guidelines.

Background

Release of hazardous materials along the Wachusett Reservoir watershed's transportation corridors has consistently been considered a high potential threat to water quality. The 1998 Plan reassessed the threat posed by releases from contaminated sites to low due to, among several factors, the small number of fixed sites in the watershed and that these sites are permitted and regularly inspected (see **Section 5.2.2**). This section specifically addresses emergency response planning associated with the threat of transportation related accidental spills or releases of hazardous materials.

Current Program and Accomplishments

A Hazardous Materials Emergency Response Study, commissioned by the Bureau in 1997, developed a comprehensive response plan that has been implemented during the past five years. The study determined that the greatest benefits to response capacity would be achieved by improving the existing responders' resources (i.e., local fire departments' equipment and training). The Bureau also monitors a DEP database of generators and volumes of hazardous materials to help with this emergency planning.

Local Coordination

BWM has coordinated several meetings of agencies and industries having an interest in emergency response planning in central Massachusetts. Representatives from the local Fire Departments, railroad companies, Federal Railway Administration, Federal Emergency Management Agency, MA Emergency Management Agency, MWRA, State Police, BWM, and EPA have attended BWM sponsored meetings. In November, 2002, twenty-five Fire Chiefs, Hazardous Release Response Coordinators, Local Emergency Planning Commission members, and Town Administrators attended a half-day training sponsored by the BWM. Presentations from DFS/Emergency Response, Providence & Worcester and Guilford Railroads, MEMA LEPC Action Plan Update Process, MA Firefighting Academy, and BWM covered each agencies responsibilities, contributions, and

limitations in the event of a release. Information was distributed listing each agency's available equipment and expertise, typical response procedures, and additional training opportunities.

The Bureau entered into a Memorandum of Agreement with the Wachusett Reservoir watershed communities' Fire Departments for Boat Use and Maintenance. This MOA will provide the communities with access to a functioning boat for emergency operations and helps protect the interests of the Bureau if a spill occurs in or near a water body.

The Household Hazardous Products Committee, a consortium of Wachusett Reservoir watershed communities hosted by the Town of Sterling, received \$25,000 in 1999 for an educational and public awareness program. These funds paid for the set up fees for four hazardous waste collections. The program enabled the Town to hire a consultant that provided numerous educational programs throughout the region. Sixteen in-class presentations were made at schools in Paxton, Rutland, Holden, Sterling and Princeton. Three presentations were also made at local Lions Clubs and the Wachusett Rotary club. These presentations focused on the use of alternatives to hazardous products.

Hazardous Material Emergency Response Equipment

In coordination with the MWRA, BWM staff has obtained materials that will be made available in trailers to local responders in the event of a hazardous material release on land, in a tributary or on the reservoir itself. The equipment has been specified to augment the existing supplies of the local responders for the specific needs associated with the fact that they are tributary to a drinking water supply.

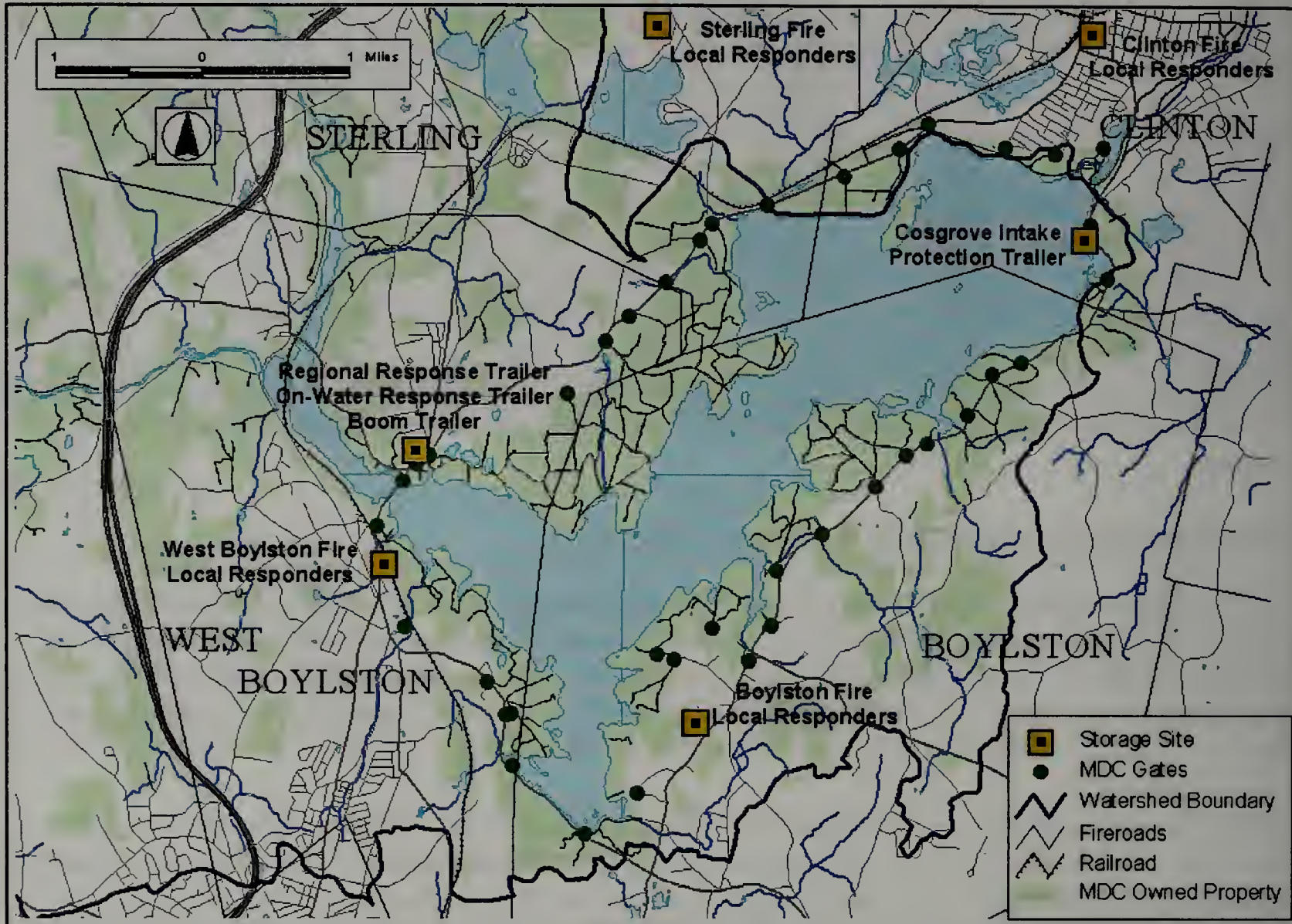
Four trailers and appropriate equipment have been positioned in key locations around the Wachusett Reservoir. Local responders are equipped to drive to these locations and connect the trailers to a truck and take the trailers to the emergency site. There are four distinct emergency response trailers: a Regional Response Unit, On-Water Response Unit, Boom Trailer, and an Intake Protection Unit (see Figure 6-4).

Spill containment equipment is also being purchased and will be housed at the Cosgrove Intake Area which will be used to impede floating materials from coming within 150 feet of the intake. An emergency spill containment system was installed at the BWM boat cove to block the transport of buoyant materials out of the cove.

The Bureau conducted in-house training for communications staff to afford them Emergency Response-Awareness level certification. Field staff received training and certification to the Emergency Response-Operations Level. This training consisted of eight hours of classroom instruction in personal safety, threat identification, emergency notifications and procedures, a tabletop exercise, and exam. The Bureau also conducted Incident Command Training for all staff to make them aware that the process existed, how it works, and how they fit into the response system.

Three local fire Chiefs and deputies, and a BWM staff member attended a mock response action at MWRA's Deer Island Facility in Boston. They deployed, anchored, and retrieved 1,500 feet of containment boom similar to what may be needed in the event of a release in the reservoir.

Figure 6-4: Emergency Response Equipment Locations



Local Spill Kits

The purchase of hazardous materials emergency response equipment (Spill Kits) was completed and distributed to all the communities in the Wachusett Reservoir watershed. The equipment will enable watershed towns to respond to a maximum of a 2,000 gallon petroleum product release, and provides personal protective gear for the response.

Assessment

The Bureau prioritizes the level of water quality threat by an accidental spill or release based on several factors, including: the specific product that was released, the volume of product released and the location of the incident. The impact of a spill or release would be most critical in the Reservoir Basin, less critical in the Central Basin (upstream of the Rt. 12 causeway), and least critical in the Worcester Watershed Basin. The roads with the highest volume of hazardous materials in the Wachusett Reservoir watershed, however, are located in close proximity to the reservoir itself.

BWM has made considerable progress in augmenting the resources available to the region's first responders. Ongoing planning, communication and training exercises will further complement the preparedness of all those who are responsible for emergency response in the watershed.

Control Approach

Goals

- To ensure prompt, effective response actions to accidental spills or releases of hazardous materials.
- To reduce the volume of hazardous materials in the watershed.

Objectives

- Maintain and improve capabilities of all emergency responders in the watershed for hazardous materials spills or releases.
- Maintain information about hazardous material use in the watershed.

Action Items

- Refine participants and responsibilities in the Hazardous Materials Emergency Response.
- Support annual training and equipping of BWM staff and local responders. Coordinate drills and communications to maintain and improve cooperation among State and local responders.
- Prepare and maintain plan that prioritizes responses on BWM property, and assist communities with update and preparation of their Comprehensive Emergency Response Plans.
- Coordinate with active railroad companies on security and freight issues within state and federal guidelines.

6.4 Other Pollution Sources

The 1991 Plan identified a variety of potential sources of contamination and prioritized their threat level. Many of these potential sources were ranked low, or were subsequently reduced to a low priority by the 1998 Plan Update, due to the control programs in place. The Bureau's monitoring programs (see **Section 5**) provide many of the measures necessary to control the following sources of pollution:

- Gas/Petroleum Storage
- Road Salting
- Gravel Mining
- Solid Waste Facilities
- Groundwater Discharges
- Hazardous Waste Generators
- Uncontrolled Releases from Fixed Sites.

This section describes the few remaining land uses that are either a medium priority, have been reduced to a low priority by the Bureau, or have consistently maintained a low priority but nevertheless require staff resources.

6.4.1 Construction (Erosion and Sediment Control)

Accomplishments:

- Continued to work with local Boards in reviewing development projects.
- Monitored active construction sites.
- Completed Construction Guidelines for in-house review of development plans.
- Reviewed erosion and sediment controls as part of the Watershed Protection Act application process, including plan review, meetings with developers and on site inspections.
- Acquired lands sensitive to erosion in the watershed.

Assessment:

BWM staff spends a significant amount of time reviewing site plans, meeting with developers and monitoring construction sites to implement actions that prevent sediment from entering resource areas.

Key Actions:

- Continue reviewing site plans and meeting on site with developers to discuss erosion and sedimentation controls.
- Implement monitoring program for active sites.
- Pursue compliance and enforcement of all appropriate environmental regulations.

Background

Construction poses a pollution threat from site erosion into resource areas. Authority to prevent such erosion can be found in a number of regulations, including the Watershed Protection Act (350 CMR 11.00), the Wetlands Protection Act (310 CMR 10.00), the Massachusetts water quality standards (310 CMR 4.0), and BWM regulations (350 CMR 11.09).

Current Program and Accomplishments

Environmental Quality staff attempts to minimize erosion by reviewing construction projects before they start. The Watershed Protection Act, which allows review of projects in affected areas, is the Bureau's major tool to accomplish this task. Projects that are not subject to the Watershed Protection Act may also be of concern. In this case, staff works with the local boards, generally the conservation commission, to see that resources are protected. Staff conducts site visits when a project is submitted, and evaluates the controls presented in the site plan. During construction, additional site visits are conducted to ensure that controls are constructed and working as designed. If problems are noted, BWM staff works with the property owner and local officials to install corrective measures.

Assessment

Erosion of sediment into watershed resource areas can cause serious environmental problems. Erosion from construction sites results in loss of resource areas and is harmful to wildlife. BWM staff work diligently to minimize erosion by reviewing sites prior to the start of construction. Problems often arise because proponents do not follow the erosion and sediment controls agreed to when the site plan was reviewed. Although some property owners are cooperative, the threat of enforcement is sometimes needed to ensure that corrective actions are taken. If problems occur on a site that is subject to the Watershed Protection Act, BWM can take direct action based on these regulations. If problems occur on a site that is not subject to the WsPA, BWM will coordinate with the conservation commission, asking them to take the lead on enforcement. If the conservation commission is not able or does not want to take enforcement action, BWM can proceed using 350 CMR 11.09, the general watershed protection regulations.

Control Approach

Goals

- To minimize erosion and sedimentation from active construction sites in the Wachusett Reservoir watershed.

Objectives

- Provide input to projects at design stage in order to minimize potential for erosion.
- Actively monitor sites to ensure that site controls are implemented and maintained.
- Take appropriate corrective and enforcement action when erosion into resource areas is found.

Action Items

- Continue to review projects through WsPA, working with conservation commissions and other local boards.
- Monitor active projects through on site inspections and water quality testing.
- Pursue compliance and enforcement of all appropriate environmental regulations.

6.4.2 Agriculture

Accomplishments:

- Implemented BMPs at seven priority sites through a grant by the USDA Natural Resources Conservation Service (NRCS) that was administered by the MA Dept. of Food and Agriculture (DFA).
- Initiated negotiations for BMPs on two additional sites.

Assessment:

There are few farms remaining in the Wachusett Reservoir Watershed due to sales and conservation acquisitions. BWM's collaboration directly with farmers and with other agencies that support agriculture, such as the DAR and NRCS, has helped to minimize the impact the remaining farms have on water quality in the Wachusett Reservoir.

Key Actions:

- Monitor agricultural impacts through EQAs; follow policy to contact agricultural land owner if there is a violation of watershed regulations.
- Update status of sites identified as most important in 1998 Plan. Evaluate effectiveness of installed BMPs.
- Identify and locate new hobby farms.
- Assess opportunities to educate hobby farm and nursery/landscape operators on water quality issues.
- Coordinate with DAR and EOEA to integrate water quality objectives into their agricultural outreach materials.

Background

From the period of its initial development as a water supply through the 1950s, agriculture was the principal land use in the Wachusett Reservoir watershed. BWM's regulations reflect a concern regarding agricultural activities:

- 350 CMR 11.09 states that "No person shall...construct, establish or maintain any agricultural facility or place where animal manure may be deposited or accumulated without adequate provision to prevent any manure or other Pollutant from flowing or being washed into the Waters of the Watershed System."
- 350 CMR 11.04 prohibits the outdoor storage of fertilizers, herbicides, pesticides, and manure within certain areas of the watershed.

Since the end of World War II, the number of active farms in the Wachusett Reservoir watershed has declined, similar to trends seen in other areas of the Commonwealth. Agriculture operations comprise a small portion of the watershed land use. In the 1998 Plan, MassGIS land use data from 1992 showed that agriculture makes up 3% of the total Quabbin Reservoir watershed land use, 5% of the total Ware River land use, and 8% of the total Wachusett Reservoir watershed land use. Using updated 1999 land use data, agriculture now comprises 7.2% of the land use of the Wachusett Reservoir watershed. These land use figures overstate the extent of agriculture, because many of the areas defined as agriculture on the land use GIS coverage (based on photo-interpretation) are not being actively farmed. The actual percentage in the Wachusett Reservoir watershed, based on BWM staff observation, may be less than 5%.

Current Program and Accomplishments

The 1998 Plan considered potential water quality threats from agricultural practices under two categories: Herbicides/Pesticides/Fertilizers usage, and Livestock & Crops. These categories were assessed as High Potential Threats to water quality. The Plan proposed a cooperative approach, working with other state and federal agencies, including Massachusetts DFA and the USDA NRCS.

Twelve farms were identified by MDC/DWM in 1998 as the most significant agricultural operations in the watershed. In the spring of 2000, MDC offered financial assistance (\$45,000 in grants) for ten best management practices (BMPs) on seven sites. The DFA and NRCS offered assistance (\$30,000) for seven BMPs on two of the same and one additional site. Nine of the BMPs have been completed at a cost of \$48,000; the remaining eight are still under construction (see **Table 6-2**). Water quality improvements have also been made at some of the other farms without assistance from other funding sources. Targeted monitoring has not been conducted at these sites; impacts are being identified through routine Environmental Quality Assessments (see **Section 5.3**).

BWM has worked with its sister EOEAs on a variety of fronts dealing with agriculture and water quality issues. The Bureau has coordinated with DAR in several ventures, including participation on the Agricultural Advisory Group, an exploration of ways to promote composting for small scale farms, and identification of agricultural land for non-BWM protection. DEP developed some educational materials for horse owners that the Bureau can utilize for its educational purposes. The Water Resources Commission produced a "Guide to Lawn and Landscape Water Conservation" in 2002 which identifies a myriad of management solutions to water use, including limited use of chemicals; several of these tips were included in a Watershed Protection Act brochure on landscaping (see **Section 5.2.1**). The Bureau continues to investigate potential agricultural BMP with other water suppliers and professional organizations.

Assessment

Many watershed residents consider farming a community resource that is an important component of community character, as well as a help to preserve open space. As much as it is a cherished part of the landscape, farming can have negative impacts on water quality. BWM's goal is not to eliminate agriculture but to control the greatest threat to water supply posed by these activities, which is contamination from animal wastes containing pathogens. Assessment of actual risk is very complicated due to the many unknowns about transport, fate, viability, infectivity, dosage, problems with existing testing methods, and other factors that must be considered to evaluate actual risk posed by livestock. Other pollutants, including nutrients, pesticides, and suspended solids, may be generated by livestock, crop production and nursery/landscape operations. These compounds all pose a potential threat to water quality, but are considered a lesser health risk than pathogens. Overall, however, agriculture that is properly conducted should pose a very limited risk to water supply.

Agricultural use is dynamic. The survey conducted by CEI for MDC is a "snapshot" of activities in the watershed circa 1997. These data does demonstrate, however, that the majority of farms in the Wachusett Reservoir watershed are small-scale operations. Few farms have more than 100 animals; many can be considered "hobby farms" or "gentleman farms." The Bureau needs to develop a process to identify and locate all of the minor agricultural uses in the watershed. It is also important

to note that most of the larger farms are located in the Worcester sub-watershed, which is the area most remote hydrologically from the reservoir.

Table 6-2
Status of Priority Agricultural Sites in the Wachusett Reservoir watershed – March 2002

TOWN	ADDRESS	BMPs	COST	STATUS
Boylston	Diamond Hill Ave.	▪ Fencing	none	No activity.
Holden	Manning St.	▪ Fencing	\$1,000	Complete.
	Bond Rd.	▪ Fencing and seeding ▪ Manure storage	\$28,000	Fencing and seeding complete; ramp to manure pit needed.
	Malden St.	▪ Roof for manure storage ▪ Sand filter	\$8,000	Complete; additional fencing also installed.
	Bryant Rd.	▪ Fencing ▪ Watering device	none	No activity.
Rutland	Glenwood Rd.	▪ Manure storage pad ▪ Fencing	\$3,800	Incomplete – delay due to fire at farm.
	Muschopauge Rd.	▪ Manure storage pit ▪ Fencing and seeding ▪ Filter field ▪ Barnyard management ▪ Gutters	\$17,500	Complete.
	Hillside Rd.	▪ Fencing	\$2,200	In progress.
	Maple Ave.	▪ Fencing ▪ Pad and roof for manure storage	\$8,000	Storage to be designed by NRCS.
Sterling	Lucas Rd.	▪ Filter strip ▪ Roof for manure storage	none	Complete; self-funded
West Boylston	Prospect St.	▪ Manure storage pad and roof ▪ Fencing ▪ Watering device	\$6,500	Fencing complete; remaining BMPs in progress.
	Valley Forge Cir.	▪ Sand filters	none	No activity.

Source: DCR/DWSP/BWM EQ, 2003

The 1998 Plan focused on potential pathogen contamination and placed agriculture on a higher level of concern than in 1991. BWM dedicated significant resources to working with farmers and federal and state agricultural agencies to correct water quality problems related to agricultural practices. Combined with the continuing decline of farm and agricultural operations, agriculture has been reduced to a low priority threat.

BWM has developed and implemented a policy for working with land owners to correct water quality problems caused by agricultural operations. BWM staff have visited and inspected the most significant farms in the watersheds. The policy is summarized below:

- BWM staff are alerted to a potential problem via a complaint, as a follow-up to water quality

sampling results, or as part of routine Environmental Quality Assessment. An appointment to visit the site is made with the landowner.

- BWM staff visit the site to investigate potential causes of the observed problem, and explain BWM concerns to the landowner. Staff evaluate conditions as they relate to BWM regulations to determine if there is a violation of the regulations.
- If a violation of BWM regulations is noted, staff explain to the landowner that a Notice of Violation will be issued by BWM.
- BWM staff contact NRCS, and arrange to make a follow-up, cooperative visit by BWM and NRCS staff. Corrective actions, including agricultural BMPs are suggested. NRCS informs the landowner of any available funding sources for the corrective measures.

Control Approach

Goals

- To minimize the potential for agricultural wastes and chemicals to leave the source and to enter tributary waters of the reservoir, focusing first on pathogens.

Objectives

- Collaborate with landowners and appropriate state and federal agencies to develop cooperative solutions to agricultural-related water quality problems.

Action Items

- Monitor agricultural impacts through EQAs; follow policy to contact agricultural land owner if there is a violation of watershed regulations.
- Update status of sites identified as most important in 1998 Plan. Evaluate effectiveness of installed BMPs.
- Identify and locate new hobby farms.
- Assess opportunities to educate hobby farm and nursery/landscape operators on water quality issues.
- Coordinate with DAR and EOEA to integrate water quality objectives into their agricultural outreach materials.

6.4.3 Private Forestry

Accomplishments:

- Provided technical and monetary assistance to landowners to develop Forest Management Plans for their private properties

Assessment:

Thirty four Forest Management Plans, totaling 2,115 acres, have been funded on the Wachusett Reservoir watershed. These management plans provide additional measures of watershed protection by promoting properly designed timber harvesting practices on private lands. The Chapter 61 program, which provides tax benefits to owners of forested or agricultural lands who register their property, is an important conservation tool.

Key Actions:

- Provide public education/technical assistance to private landowners to develop land management plans and enter Chapter 61 programs.
- Maintain inventory of Chapter 61, 61A protected lands, assess management practices, and work with owners where needed.
- Continue periodic review of forest cutting plans and private forestry practices

Background

The Bureau started a program of direct technical assistance in 1995 to forest landowners at the Wachusett Reservoir watershed. At that time, there were over 26,000 acres of unprotected forest lands in the watershed. A Private Lands Forester was hired using funding provided jointly by MDC/DWM and the USDA Forest Service (in conjunction with the Department of Environmental Management). The need for a Private Lands Forester had been identified in the Quabbin Land Management Plan. This forester assisted DEM foresters in administering MGL c. 132 –the Forest Cutting Practices Act –in the Wachusett Reservoir watershed. Other duties included providing outreach to private landowners to encourage land protection through programs such as Chapter 61 and the Forest Stewardship Program. As recommended in the 1991 Watershed Protection Plan, the forester also encouraged general use of the Bureau's Conservation Management Practices for forestry operations on watersheds. The Private Lands Forester worked to encourage private landowners to manage their forests and wildlife to meet watershed-wide goals, looking beyond their individual property boundaries and designing management strategies that address the issues of the larger ecosystem.

Current Program and Accomplishments

In order to increase landowner participation in Chapter 61 and the Stewardship programs, the Bureau contracted to hire private consultant foresters to complete forest management plans for landowners wishing to gain entry into these programs. In FY 95, \$40,000 was dedicated to completing plans for approximately 3,700 acres of private forestland and to cost-share practices that benefit the watershed, such as tree planting and erosion control on roads. BWM's technical assistance to

landowners to date has resulted in the addition of several hundred acres to Chapter 61, and the completion of forest management plans on 2,115 acres within the Wachusett Reservoir watershed.

While the full-time private lands forester position ended in 1998, BWM staff has continued to perform outreach and forest management plan funding through a series of contracts in the three watersheds to encourage good practices and to aid land owners in entering the Forest Stewardship and Chapter 61 programs.

Assessment

Providing technical and monetary assistance to individual landowners is an effective way to promote properly designed timber harvesting practices on private lands. Encouraging appropriate and sound forest management on private land reduces the likelihood of development and promotes a diverse forest cover.



A well-planned silvicultural site.

Control Approach

Goals

- To encourage owners of privately held forested land to practice sound forest management.

Objectives

- Continue to help landowners maintain their property in an undeveloped state.
- To support landowners to implement forestry Conservation Management Practices and maintain a healthy, species diverse, multi aged forest on their property.

Action Items

- Renew the three year contract for private lands stewardship assistance.
- Continue to review all forest cutting plans that occur on the watershed.

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7 Infrastructure

The DCR/MWRA Drinking Water Supply System is an engineering marvel. Starting with cisterns in colonial Boston, the system has grown to encompass lands and water over 100 miles to the west. The BWM Watershed System (Wachusett Reservoir, Quabbin Reservoir, Ware River and Sudbury Reservoir (the emergency supply)) delivers 250 million gallons a day to the MWRA to distribute through its transmission system to 47 communities. Continual inspections, maintenance and improvements are required in order to provide the consumer with clean, safe drinking water. The events of September 11, 2001 have raised additional security concerns which both agencies have addressed in their facility management. The MWRA and the BWM are completing a significant phase of infrastructure improvements, ensuring pure water for generations to come.

7.1 BWM Facilities

Accomplishments:

- Maintained the existing water supply dams and related hydraulic structures, bridges, roads and fire roads, and individual buildings and facilities.
- Constructed the Wachusett Reservoir Boat Cove Docking Facility in Clinton.
- Completed remedial repairs and improvements to the Beaman St. Bridge in West Boylston.
- Initiated underwater inspections of Wachusett Dam and Cosgrove Intake Facility.

Assessment:

Much of the infrastructure in the Wachusett Reservoir watershed is approaching 100 years in age. Maintenance of these facilities is crucial to the ongoing delivery of pure water to metropolitan Boston.

Key Actions:

- Complete underwater inspections of Wachusett Dam and Cosgrove Intake Facility; develop necessary repair designs from inspections.
- Proceed with Spillway improvements and North Dike modifications.
- Update existing Emergency Action Plans.
- Install specialized instrumentation and sensing devices at Bureau dams.
- Coordinate with MWRA on infrastructure projects.

Background

The Bureau of Watershed Management is responsible for six major water supply dams, six other major dams, 60 small dams, 419 miles of roads and fire lines, and 14 bridges throughout the watershed system (see Fig. 1-1). There are 65 separate facilities ranging from administrative offices to maintenance garages and storage sheds throughout the watershed system.

The dams that create the storage reservoirs are the heart of the watershed system. The dams associated with the entire active and active reserve elements of the water supply system include: the Winsor Dam, Quabbin Spillway and Goodnough Dike in the Quabbin Reservoir watershed; the

Ware River Dam and Intake at Shaft 8 in the Ware River watershed; the Quinipoxet Dam, Wachusett Dam and Spillway, North and South Dikes within the Wachusett Reservoir watershed; and the Sudbury, Stearns, Brackett and Foss Dams (the latter three often referred to as, respectively, Framingham 1, 2 and 3) on the Sudbury River. The reservoirs are connected by means of aqueducts that allow water to be transferred from within the watershed system itself and to the MWRA distribution system aqueducts and treatment facilities. Water is also supplied from Quabbin Reservoir to Chicopee and surrounding towns via the Chicopee Valley Aqueduct.



Historic photo demarcating annual progress of construction on Wachusett Dam, 1902-1905.

While the primary purpose of this extensive system of dams and reservoirs is to provide water supply, the dams and reservoirs are designed and operated as an integrated system with multiple objectives, including flood control, fish and wildlife propagation and aesthetics. The system is operated to:

- Optimize delivery of high quality water for drinking water supply.
- Ensure adequate volume in storage to respond to fluctuations in precipitation and demand.
- Meet downstream minimum flow release requirements.
- Prevent violation of minimum pool reservoir stage limitations.
- Maximize rainfall capture while minimizing spillage and control downstream flooding.

The system operates within a strict regime of regulatory and statutory constraints which dictate the operation and management of the system.

In addition to the major water supply dams in the system, there are approximately 60 other dams that perform various functions and fulfill a variety of needs at the local level, principally in terms of

flood control, recreation, fisheries and wildlife propagation, while also contributing to the operational reliability of the water supply system. Another benefit of the configuration and hydraulics of the system is the opportunity to generate revenue from hydroelectric power generation. Hydroelectric generating stations are located at the Quabbin Aqueduct Outlet at Oakdale and the Cosgrove Intake at Wachusett Reservoir; they are currently not in operation.

The Winsor (Quabbin), Wachusett and Sudbury dams fall into the “Large Size - High Hazard” category and are maintained and operated by BWM to meet Federal Energy Regulatory Commission (FERC) safety standards. The remaining dams are inspected and programmed to meet, at a minimum, the state’s Office of Dam Safety standards, and, when practical, the higher standards set by the U.S. Army Corps of Engineers.

The BWM has a dedicated staff of in-house civil engineers who perform routine periodic inspections on a planned schedule for all dams within the system. In order to ensure compliance with stringent federal requirements, engineering consultants are employed to perform more in-depth investigations and studies of hydraulics, soils, and geo-technical conditions to guide major capital maintenance and repair projects.

Conditions affecting the operation of any of the Bureau’s dams could result in a hazard to life and/or property due to high reservoir levels or a sudden release of large volumes of water. Emergency Action Plans (EAPs) describe in detail the overall duties and responsibilities of the operational and emergency personnel within the BWM as well as a general description of duties and responsibilities for other agencies, such as MWRA and the local community public safety agencies. The EAPs for Quabbin, Wachusett, Sudbury, and Framingham 1-3 all meet FERC requirements; all other impoundments’ EAPs are prepared to meet U.S. Army Corps of Engineers’ standards.

BWM is responsible for the planning, design and construction associated with dam projects. While establishment of dam and system operating policies is the responsibility of the BWM, operation of the water supply dams and system components is shared by the BWM and the MWRA. Flood control operations are also shared by the two agencies. Hydroelectric facilities are operated and maintained by the MWRA (revenues are paid to the General Fund by contracting utilities and offset MWRA’s reimbursement for watershed management costs). Operations policies, communications and lines of authority are delineated in accordance with a Memorandum of Understanding between the BWM and MWRA.

Current Program and Accomplishments

The BWM is continuously inspecting, repairing and planning for future improvements to the existing water supply dams and related hydraulic structures, bridges, roads and fire roads, and individual buildings and facilities throughout the watershed system. Since 1998, the most significant capital improvements in the Wachusett Reservoir watershed have been the construction of the Wachusett Reservoir Boat Cove Docking Facility in Clinton and the completion of remedial repairs and improvements to the Beaman St. Bridge in West Boylston. The former was a \$500,000 project to improve the facilities used by BWM staff to launch boats onto the reservoir for monitoring and wildlife management purposes (see **Sections 5.1.2 and 4.2.2** respectively).

BWM is conducting a system-wide program of underwater inspections and repairs of its dams and spillways. These repairs include both remedial efforts to prevent dam failure as well as the installation of state-of-the-art instrumentation. The results of the underwater inspections, along with those of the routine periodic inspections, will help determine any necessary repair work at Wachusett Dam and Cosgrove Intake Facility.



Wachusett Reservoir Boat Cove Docking Facility in Clinton.

Assessment

The watershed system's infrastructure is the product of more than a century of multi-purpose conceptualization, planning, design, construction and operating experience. The reliability and integrity of the system and its demonstrated ability to satisfactorily achieve the multiple purposes for which it was designed is unparalleled.

Much of the infrastructure in the Wachusett Reservoir watershed is approaching 100 years in age. Maintenance of these facilities is crucial to the ongoing delivery of pure water to metropolitan Boston. The ongoing program of Dam Safety will make planned improvements to the Wachusett Spillway and North Dike, as well as the installation of special monitoring devices, such as piezometers, inclinometers and wire strain gages. Due to the close relationship of the various facilities managed by the BWM and the MWRA, it is important that the two agencies effectively communicate on their different construction projects and revisions to the Emergency Action Plan in order to ensure that there are minimal impacts to water quality.

An emergency condition at the Wachusett Dam would require the coordination and cooperation of many government agencies, including the Wachusett/Sudbury Superintendent's Office, the BWM Headquarters' Office, the MWRA, and the police, fire and civil defense departments in many downstream communities that could be affected. Other involved agencies include the MA Emergency Management Agency (MEMA), the Massachusetts State Police, MA DEP, the U.S. Army Corps of Engineers, and the National Weather Service. The EAP describes in detail the overall duties and responsibilities of the operational and emergency personnel within the BWM as well as a general description of duties and responsibilities for other agencies, such as MWRA and the local community public safety agencies.

Control Approach

Goals

- To maintain the watershed infrastructure to ensure public safety, water quality and water supply.

Objectives

- Keep the watershed system's dams, dikes, roads and buildings in good, operating condition.

Action Items

- Complete underwater inspections of Wachusett Dam and Cosgrove Intake Facility; develop necessary repair designs from inspections.
- Proceed with Spillway improvements and North Dike modifications.
- Install specialized instrumentation and sensing devices at Bureau dams.
- Revise, as necessary, the Emergency Action Plan.
- Coordinate with MWRA on future infrastructure maintenance and improvement activities in order to minimize and mitigate any impacts on water quality and water treatment.

7.2 Security

Accomplishments:

- Expanded monitoring and hardening of components across the watershed system.
- Procured several response units for an accidental or intentional contamination of the reservoir, the watershed and its tributaries. Trained emergency responders, including local fire departments, BWM and MWRA staff, on the planned response actions.
- MWRA completed the Vulnerability Assessments and Emergency Response Plans on the entire watershed and distribution system as required by the 2002 Public Health and Bioterrorism Preparedness and Response Act.

Assessment:

The security of the metropolitan water system is of great importance. Since the terrorist attacks of September 11, 2001 a number of new operational policies have been enacted.

Key Actions:

Due to the sensitive nature of this matter, specific details are not included in this discussion.

Background

The terrorist attacks of September 11, 2001 forced all public water suppliers to focus their attention on the security of the water supply. Immediately following 9/11, the National Guard was deployed to guard critical components of the watershed system. The combination of specific physical improvements and the change in national security status has allowed many areas to re-open for public access; critical locations in the system, however, remain off-limits to the general public.

Current Program and Accomplishments

Several new operational policies have been enacted since September 11, 2001. Many changes in infrastructure security have also occurred, such as expanded monitoring and hardening of components across the system. BWM and MWRA have also completed procurement of several response units for an accidental or intentional contamination of the reservoir, the watershed or its tributaries (see **Section 6.3.2**). These units are specifically equipped for on-water, tributary and land-based deployment, and are prepositioned at strategic locations at each reservoir. Responders, including local fire departments, BWM and MWRA will deploy the equipment. A training component associated with the planned response actions was conducted in 2002.

On June 12, 2002 the Public Health and Bioterrorism Preparedness and Response Act became law. This law required all public water systems to complete Vulnerability Assessments (VA) on their systems. These VA's required the following:

- Characterization of the water system, missions and objectives.
- Identification and prioritization of adverse consequences to avoid.
- Determination of malevolent acts that could result in undesired consequences.
- Assessment of the likelihood of malevolent acts.
- Evaluation of existing countermeasures.
- Development of prioritized plan for upgraded to lower risk.

MWRA was the lead agency for this effort. Many months were spent on training of staff to perform the VAs, undertaking the actual assessments that systematically reviewed infrastructure components from the reservoirs through the distribution systems, and drafting the report. The final report was submitted to U.S. Environmental Protection Agency on March 31, 2003. An Emergency Response Plan (ERP) that focuses on malevolent acts was developed by the MWRA and certified by EPA in September, 2003. Detailed actions are considered sensitive to widespread distribution. There are separate plans developed for BWM specifically tailored for accidental transportation spills (see **Section 6.3.2**) and dam failure (see **Section 7.1**).

Assessment

BWM and MWRA consider security of the water system to be of the highest importance. Security of the water system must be comprehensive – source to tap – but flexible enough to adjust to a range of potential threat conditions.

Control Approach

Goals

- To provide a safe and secure water supply system.

Action Items

Due to the sensitive nature of this matter, specific details are not included in this discussion.

8 Support Programs

Previous sections of this Plan have described the Bureau of Watershed Management's core elements of Resource Protection, Monitoring, Pollution Control and Infrastructure. There are several support programs that enable these efforts and enhance their effectiveness. These support programs utilize the Bureau's wealth in both professional staff expertise and natural resources.

Offering technical assistance to local communities has been a strategy of the Bureau's watershed protection program since the initial 1991 Watershed Protection Plan. Public education and community outreach are effective ways to promote protection of the watershed's natural resources. Geographic Information Systems (GIS) – the sophisticated computerized integration of maps and data – has become the base for many of the Bureau's endeavors, as well as an important tool for local planning initiatives and administration. The vast amount of water and land under the Bureau's control is an invaluable resource for scientific study. Research projects performed on BWM property provides critical insight into the region's ecosystem, which is useful for both short-term watershed management goals and long-term biodiversity health.

8.1 *Community Technical Assistance*

Accomplishments:

- Provided direct Technical Assistance to local boards of health, conservation commissions, and planning boards by BWM staff during their meetings, through attending meetings, telephone conversations, on site visits and with GIS products.
- Tracked changes in local bylaws.
- Completed contracts for Boylston Master Plan, Rutland Master Plan, Sterling and Paxton Open Space Plans. A contract with a coalition of local Town representatives led to the successful completion of the Household Hazardous Products Committee project.
- Developed and implemented a formal contract program for the entire Watershed System. Four Wachusett Reservoir watershed towns received \$36,000 in the program's first year.

Assessment:

Most of the specific planning and regulatory tools and techniques that comprise watershed protection (for areas outside direct BWM jurisdiction) must be adopted at the municipal level through town meetings and enforced by local volunteer boards. BWM recognizes the unique "home rule" land use authority vested in Massachusetts municipalities and continues to use its expertise and resources to support local officials' decision making.

Key Actions:

- Continue board assistance through regular contact with members.
- Continue to solicit from local Boards and Commissions any interests they may have in certain areas where BWM staff are able to assist (i.e., plan review, stormwater, etc.).
- Pursue continued funding for Technical Assistance Contract Program for watershed towns.
- Monitor proposed bylaw changes.
- Provide technical information that will be of interest to watershed communities.

Background

In the Commonwealth of Massachusetts, municipalities have significant authority over land use and development. Towns are authorized to enact and enforce a variety of statutes, including zoning bylaws, subdivision bylaws, and overlay districts (such as aquifer protection bylaws). In addition, the state delegated partial authority for regulations such as Title 5 and the Wetlands Protection Act to municipal governments.

Volunteer boards are responsible for these bylaws and regulations. These boards include: the local boards of health, conservation commissions, and planning boards. Tasks that board members must perform include reviewing proposals, commenting, determining if the applicable standards are met, issuing approvals or permits, and supervising construction and other on-site compliance reviews. In many towns, especially small ones, there are few paid professional positions, and the boards may not have town staff to support them. Further, the board members may or may not have received training in that technical area. The BWM's community technical assistance program seeks to maximize the watershed protection afforded under locally delegated controls.

The BWM historically maintained contact with local boards, through the review of major development proposals, construction site inspections, and other situations pertaining to compliance with state and federal regulations. Through these efforts, the agency helped address a range of water supply pollutants, such as septic systems, sedimentation from construction, road drainage, stormwater runoff from residential area, and recreational field runoff.

The 1991 Plan established a goal to “encourage local land use controls.” The 1991 Plan focused on technical assistance in part because the passage of the WsPA, which would give MDC direct regulatory authority over land uses and activity in critical zones, was not yet assured. The 1993 Addendum to the 1991 Plan reiterated this goal and refined the need for the DWM to “encourage and support the adoption of stronger local bylaws and regulations” and “provide local assistance and develop model bylaws.” To establish effective local land use controls, DWM would provide technical assistance and funding.

MDC's involvement in local planning and environmental issues was greatly expanded with the passage of the WsPA in 1992 (see **Section 5.2.1**). The WsPA specifically required a program of technical assistance to affected communities. The WsPA directed MDC to “provide a program for technical assistance to communities impacted by this act” that includes, but is not limited to, “planning studies, and zoning bylaw studies, health bylaw studies and subdivision by-law studies” (MGL c. 92, s.108).

From 1992 to 1998, over \$400,000 in direct funding, plus DWM staff time through the Environmental Planning and Environmental Quality sections, was committed to technical assistance. This outreach affected every community in the Wachusett Reservoir watershed. Through these efforts, DWM established an effective presence at local board meetings, sparked local efforts to improve bylaws, and provided training to local officials.

The BWM Technical Assistance Program encompasses the following types of activities:

1. Growth management planning, master plans, and land use studies.
2. Review, revision, and development of by-laws, subdivision and other regulations, protective districts, and performance standards.
3. Refinement of local monitoring, review, permitting, and enforcement practices.
4. Design advice to municipal boards or landowners from natural resource, engineering, and planning professionals.
5. On-site reviews of proposed development projects with local board members and municipal officials.
6. Public education programs.
7. Applied watershed management research.
8. Technology transfer.
9. Coordinating program topics and audiences with other technical assistance organizations (such as watershed associations).

Current Program and Accomplishments

The Technical Assistance Program provides the watershed communities three different avenues to obtain help with their local land use regulatory needs:

- Board Communication
- In-House Projects
- Technical Assistance Contracts

Board Communication

Attendance at local board meetings is an effective way to foster good communication between BWM and the watershed communities. BWM presence offers both regulatory review and the opportunity to provide immediate technical assistance and, if need be, the recommendation for more in-depth consultation.

Due to fiscal constraints, attendance at local board meetings has been constrained to an as-needed basis. BWM staff have initiated a process to maintain effective communication with local boards during scheduled office hours. Direct technical assistance – reviewing project proposals, helping interpret local and state regulations; etc. – is provided during meetings, through telephone and e-mail conversations and on-site visits.

In-House Projects

There are some instances where a town requires more than a conversation to help with a project. In cases where BWM staff have time and resources, the agency provides in-house support; these projects are often associated with GIS analyses (see **Section 8.2**). It was the Bureau's experience, however, that most projects for which the towns seek assistance are too large or complicated for staff resources. The Technical Assistance Contract Program was organized to facilitate BWM sharing its financial resources with the watershed communities (see the next sub-section for a description of the projects funded through this program). Prior to 1998, the Bureau sponsored the complete costs for a

regional Household Hazardous Waste Collection in the Wachusett Reservoir watershed (see Section 6.3.2). Since 1998, MDC provided some of the set-up costs for these collections, which are held in Holden but are open to all residents of Boylston, Holden, Paxton, Princeton, Rutland, Sterling, and West Boylston. Over the last few years these collections have become self-supporting.

Technical Assistance Contracts

There are many land use planning projects that communities want to initiate that are beyond their financial means. Throughout the 1990s, the MDC, upon the request of a watershed town, would support a study or plan if finances were available. These major projects included Master Plans for Boylston and Rutland, Subdivision Regulations for West Boylston, and an Open Space Plan for Princeton.

A critique of these efforts was that the funds were distributed on a first-come, first-serve basis and that some towns were not obtaining this financial support. The 1998 Plan identified the need for a competitive program to distribute Technical Assistance contracts. Staff established a process that was implemented in FY2002.

Eleven applications from the entire watershed system, totaling \$327,644, were submitted for an estimated \$150,000 available in funding. Nine projects were eventually chosen, totaling \$151,000; five towns are in the Wachusett Reservoir watershed (see Table 8-1). Some towns were able to utilize these technical assistance contracts to enhance the money available through Executive Order 418 (Planning for Growth) to develop Master or Comprehensive Plans. Funds were not available to finance a second round of applications in FY2003.

Table 8-1
FY2002 Technical Assistance Contracts – Wachusett Reservoir Watershed

Town	Type of Project	Grant Amount	Total Project Costs
Holden	Unified Stormwater Regulation Development	\$15,000	\$20,000
Paxton	Open Space and Recreation Plan	\$5,000	\$10,000
Rutland	Contract for a Planning Agent to Assist in Implementation of Master Plan	\$25,000	\$40,000
Sterling	Open Space and Recreation Plan	\$6,000	\$12,000
West Boylston	Comprehensive Plan	\$10,000	\$75,000
TOTAL		\$61,000	\$157,000

Source: DCR/DWSP/BWM Planning, 2003

Training

Staff use the existing network of active citizens from watershed towns and boards to share information, keeping BWM staff apprised of immediate training and technical assistance needs.

Some of the key committees and groups that have historically been involved in providing technical assistance to municipalities include:

- Water Supply Citizens Advisory Committee
- Wachusett Board of Health Coalition
- Wachusett Household Hazardous Products Committee
- Wachusett/Sudbury Advisory Committee (Watershed System Advisory Committee)
- Citizens Planning Training Initiative (statewide)
- Nashua River Watershed Association.

Assessment

BWM recognizes the unique “home rule” land use authority vested in Massachusetts municipalities. Most of the specific planning and regulatory tools and techniques that comprise watershed protection (for areas outside direct BWM jurisdiction) must be adopted at the municipal level through town meetings and enforced by local volunteer boards. Thus, to accomplish the goal of utility and to improve local programs for water protection, BWM adopted the role of advocate and advisor.

By working with watershed area officials and citizens, BWM can successfully find common ground on resource protection issues. These projects help both local resources and the Metropolitan Boston water supply. The technical assistance program emphasizes local source protection and its immediate impact to watershed residents and decision-makers. Through this cooperative approach, BWM improves the land-use planning, control of development, and general environmental protection at the local level, which ultimately benefits the Bureau’s drinking water source protection. It is, however, the town’s responsibility to adopt and implement any plan or bylaw.

These support programs for the watershed communities has unfortunately faced budget restrictions due to recent fiscal constraints. BWM staff have not had the resources to regularly attend night meetings, significantly reducing face-to-face contact with many volunteer board members. Alternative communication has been arranged, such as review of projects during business hours and increased use of e-mail and voice-mail. When the budget allows an increase in spending, the Bureau will send staff to attend selected meetings.

The Technical Assistance Contract Program was also a casualty of the reductions in the FY2003-2004 budgets. The program’s implementation strategy has been established, so it can be re-started once funds become available. The communities often turn to the two Regional Planning Agencies within the watershed – Central Mass. Regional Planning Commission and Montachusett Regional Planning Commission – to perform these planning tasks. The Bureau should further strengthen its relationships with the RPAs in order to promote water supply protection strategies. A status report on each watershed town’s planning and bylaws, updating the 1993 MDC funded a report “Watershed Protection for Towns: Analysis of Existing Bylaws,” would be an opportunity to open the BWM – RPA dialogue. The increased priority of stormwater planning (see **Section 6.2**), with the dedication of Bureau resources towards assisting towns on their “Phase II” planning and implementation, will provide additional opportunities for communication and cooperative strategies in the watershed.

Control Approach

Goals

- To improve the watershed protection afforded by local land use control programs.

Objectives

- Continue an active presence within watershed communities, specifically at local board meetings, providing professional review on matters relating to watershed protection.
- Provide and coordinate training opportunities for local board members and town personnel responsive to needs and relevant to water quality protection.
- Implement and fund a contract program for the distribution of BWM's technical assistance funds.
- Coordinate funding and technical assistance with other agencies.

Action Items

- Continue regular communication with local boards. Maintain communication with boards of health, conservation commission, planning boards, public works departments and boards of selectmen.
- Provide direct technical assistance support, as requested, to local boards and community organizations.
- Implement Technical Assistance Contract Program to strengthen local planning capability.
- Track changes in local bylaws for watershed protection through regular communication with towns and Regional Planning Agencies.



8.2 Public Education and Community Outreach

Accomplishments:

- Watershed Rangers presented close to 200 programs to children in the watershed and created a watershed protection display and program for use in fairs and other public events.
- Developed a pilot curriculum for fourth grade students in the Wachusett Reservoir watershed.
- Continued involvement in teacher training, including responsibility for the Massachusetts Project WET program, assistance in the Wachusett Region Environmental Educators Network (WREEN) and participation in the Massachusetts Drinking Water Education Partnership (MADWEP).
- Developed an interpretive trail at the Stillwater Farm.
- Published seven Fact Sheets regarding watershed protection programs, eight editions of the *Downstream* newsletter, and instituted the Bureau's website.
- Erected numerous kiosks and bulletin boards around the reservoir to provide information and educational materials for visitors.

Assessment:

BWM has an established program of public education for students, local residents and visitors on importance of watershed and resource protection. Education is provided in a variety of ways, using direct and indirect contact with individuals and groups. Direct contact includes educational programs through local schools, interpretive programs on BWM properties and education by rangers through casual contact with visitors. In addition, staff provide training for teachers in watershed education. Indirect education occurs through the use of kiosks, bulletin boards and signs, the *Downstream* newsletter and other publications, and the BWM website.

Key Actions:

- Continue to develop, implement, and expand curriculum developed for the Wachusett Regional School District.
- Continue to manage Project WET and support other state environmental programs including Project WILD, Project Learning Tree and the Envirothon.
- Continue to offer in-school and field programs to watershed school systems.
- Develop programs and exhibits at Stillwater Farm.
- Expand use of kiosks and bulletin boards to educate visitors.
- Prepare outreach materials for the general public and media on DCR and general watershed topics.
- Continue to develop website to provide educational resources on watershed management topics.
- Continue publication of the *Downstream* newsletter. Assess topics and distribution process.

Background

Educational programs are an effective way to protect watershed resources by instilling a better understanding and appreciation of stewardship of natural resources. Many water suppliers incorporate interpretive services into their watershed protection programs to enhance their message of water quality and resource protection. The BWM has effectively used public education to enhance its watershed protection for many years, providing outreach and education throughout its watershed system to residents, students, teachers, public officials and visitors. The Quabbin Visitors Center, established by the Legislature in 1985, had served as the major avenue for information and

education about the watershed system. The relatively recent development of the Watershed Ranger program has broadened the scope of the education efforts by providing a venue for a program in the Wachusett Reservoir watershed.

The 1991 Watershed Protection Plan began the formulation of a more expansive outreach program. Although education was not listed as a specific program, the Plan did provide for technical assistance on a number of topics within the action items. The 1996 Wachusett Public Access Plan further expanded public education in calling for development of a Ranger staff that would provide education on rules enforcement and watershed protection through contact with visitors to watershed properties. The 1998 Wachusett Reservoir Watershed Protection Plan formalized the public education program and set forth goals for public education and interpretive services.

Current Program and Accomplishments

Public Education

School programs have been shown to be an effective method for disseminating environmental education. BWM has made education through schools an important component of its resource protection program. BWM has been involved in several education networks, including Massachusetts Drinking Water Education Partnership (MADWEP) and Wachusett Region Environmental Educators Network (WREEN). The Bureau has been the state sponsor of Project WET (Water Education for Teachers) since 1996, providing the administrative staff for this national program. There are currently 102 facilitators in the Project WET network. From 1998 to 2003, the Bureau has held 122 workshops, training 1,757 teachers to use Project WET materials. Watershed Rangers and other staff have themselves provided hundreds of programs in watershed schools over the years. General public education focuses not only on Ranger contact with visitors but also includes the development and use of a watershed protection display and program for fairs and other public events, the utilization of kiosks and bulletin boards around the reservoir to disseminate information and educational materials, and the use of written publications and the agency's website.

Stillwater Farm

The Stillwater Farm site provides a unique opportunity to visually and programmatically demonstrate the relationship between land use and water quality. This historic property was originally settled in 1790 and grew at one point to a 300 acre dairy farm with a unique salt box barn. Approximately 230 acres of the farm site were purchased by the MDC in 1990 for watershed protection purposes after they were placed on the market for commercial and residential development. The property is situated atop the Stillwater Aquifer, the largest in the watershed, and much of the land abuts the Stillwater River. Shortly after its acquisition, MDC entered into a partnership with The Friends of Wachusett, a non-profit organization, to develop a watershed interpretive site that preserves the farm's natural and historic resources.

Plans for Stillwater Farm include renovation of the home and barn as well as landscape level educational opportunities. BWM has established a woodland interpretive trail that demonstrates forest succession; future exhibits could include a wetland and floodplain delineation trail, interactive groundwater monitoring wells, or an outdoor soil profile display. The Friends of Wachusett and BWM have received over \$200,000 in grants and donations, including a recent \$6,000 grant for curriculum development from the Natural Heritage Trust.



Stillwater Farm.

Community Outreach

BWM staff prepared seven fact sheets on a range of topics related to the Bureau's activities, including: Hazardous Materials, Land Acquisition, Public Access, Silviculture, Water Quality, Watershed Protection Act, and Wildlife Control. A primer on Growth Management Tools was also produced and distributed by the Bureau. The Natural Resources Section initiated a semi-annual newsletter, *Downstream*, which presents topics of interest to landowners in Central Massachusetts, such as Invasive Species, Conservation Restrictions, and Green Landscaping. It is mailed to all landowners of 10 acres or more in the watershed system. All of the fact sheets, newsletters, and other watershed management related materials have been posted on the agency's website.

Assessment

BWM has developed and implemented a strong program of public education for students, local residents and visitors that focuses watershed and resource protection. The Watershed Rangers and other staff offer educational programs through local schools, interpretive programs on BWM properties and casual contact with visitors. The rangers ability to provide in-school lessons has been curtailed due to the increased need for their security functions. Stillwater Farm is being developed for educational use through a Memorandum of Agreement with the Friends of Wachusett, a non-profit community organization. Once renovations are completed in 2003, the farm house will be used as an interpretive center.

DCR staff provide a significant role in training teachers in watershed education curriculum through the statewide coordination of ProjectWET. Public outreach, through the use of kiosks, bulletin boards, signs, the *Downstream* newsletter, referral or dissemination of technical publications, and the BWM website, is an important process in the ongoing effort to involve all citizens, both residents and visitors, in contributing to watershed protection.

Control Approach

Goals

- To foster an attitude of stewardship of the land and water resources of the watershed system among area residents, businesses and visitors.
- To promote an understanding of the physical, chemical, and biological properties and functions of surface water, groundwater, wetlands, and aquifers, as well as the relationship between land use and water quality.
- To promote widespread knowledge of, and voluntary compliance with, BWM's Rules and Regulations and the public health significance of these rules.

Objectives

- Provide in-school programs to educate children on watershed management issues.
- Facilitate other parties to provide water supply protection educational materials.
- Educate the public about watershed management topics and BWM's Rules and Regulations through both direct and indirect methods of communication.
- Utilize Stillwater Farm as an interpretive center.

Action Items

- Continue to develop, implement, and expand curriculum developed for the Wachusett Regional School District.
- Continue to manage Project WET and support other state environmental programs including Project WILD, Project Learning Tree and the Envirothon.
- Continue to offer in-school and field programs to watershed school systems.
- Develop programs and exhibits at Stillwater Farm.
- Expand use of kiosks and bulletin boards to educate visitors.
- Prepare outreach materials for the general public and media on DCR and general watershed topics.
- Continue to develop website to provide educational resources on watershed management topics.
- Continue publication of the *Downstream* newsletter. Assess topics and distribution process.

8.3 Geographic Information Systems

Accomplishments:

- Provided mapping and data information to all BWM Sections, including Natural Resources, Environmental Quality, Forestry, Education and the Sewer Project.
- Assisted local municipalities and non-profit organizations with map products to aid projects in the watershed that will enhance water quality.
- Developed map and data information request protocol for use by staff, municipalities and other watershed partners.

Assessment:

The functions of the GIS Department are an integral part of all the other BWM sections. The maps and analysis produced by the GIS staff provide other Bureau staff with the information necessary to complete their tasks in an accurate and timely manner. In addition, watershed towns and non-profit organizations are able to benefit from this information.

Key Actions:

- Update digital information, including all new BWM land purchases, Watershed Protection Act maps and parcels, and provide analyses for use in Bureau reports and publications.
- Continue support to municipalities and non-government organizations by providing GIS products and technical assistance.
- Continue to update the Wachusett Reservoir Watershed Land Acquisition Model to determine priority land for purchase.

Background

A geographic information system (GIS) is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information (i.e., spatial data). This system includes hardware (computers, printers, plotters, scanners, digitizers, GPS units, etc.), software (programs like ArcInfo and ArcView), data (roads, town boundaries, parcels, aerial photographs, etc.), and staff. A GIS belongs to a family of mapping and drafting programs that includes computer-aided design (CAD) and automated mapping and facilities management (AM/FM); it is distinguished from these other programs by its capacity to perform complicated analytical functions that often include combining information from different sources to derive meaningful relationships.

The Division of Watershed Management initially used GIS for creating rudimentary maps in the 1991 Watershed Protection Plans. The passing of the Watershed Protection Act (WsPA) in 1992 forced DWM to quickly evolve its GIS program. The WsPA required the Division to develop GIS maps for the watershed system that would enable the identification of both regulatory buffers and affected landowners. At that time, the utilization of GIS for defining regulatory areas was a state-of-the-art application. The Division subsequently used its GIS to create a Land Acquisition Prioritization model. Integrating a range of criteria through an Analytical Hierarchy Process, the GIS was able to take advantage of accurately computerized topography, hydrology, land use and ownership data to establish a process that maximized the funds spent on land acquisition.

The Bureau has worked closely with MassGIS, the Commonwealth's Office of Geographic and Environmental Information, which is within the Executive Office of Environmental Affairs.

MassGIS, created in the late 1980s, is the official state agency assigned to the collection, storage and dissemination of geographic data. The collaboration between BWM and MassGIS has provided the technical support necessary for the Bureau to maintain a high level of GIS services.

Current Program and Accomplishments

The BWM GIS staff are continuously manipulating data to support the various needs of the Bureau. All applications submitted for the Watershed Protection Act have a map produced depicting the parcel location and its WsPA regulatory buffers (**see Section 5.2.1**). Maps and analyses have been produced on a regular basis to help with the forestry, wildlife management, land acquisition, environmental quality monitoring, and education elements of the Bureau. The GIS staff worked closely with other staff to produce Emergency Response reports, the Wachusett Reservoir Land Management Plan, the Wachusett Reservoir Watershed Public Access Plan Update, and this Watershed Protection Plan Update. ArcView GIS software and training were deployed throughout the Bureau, enabling all professional staff to have access to GIS maps and information. The GIS program assures that quality standards are met for all the data maintained by BWM.

BWM also offers its GIS services to watershed communities, supporting the efforts of planning boards, conservation commissions and open space committees with maps and digital information. This technical assistance is also provided to local non-governmental organizations, such as land trusts and greenway committees. The Bureau receives, on average, one request per month for services such as site suitability maps, zoning maps, Watershed Protection Act maps, and digital data for planning initiatives. A protocol was established in 2002 to properly manage these requests from outside the Bureau.

The GIS Staff work toward better understanding their constantly changing field by regularly attending regional GIS User Conferences. A bathymetric analysis of Wachusett Reservoir, utilizing data from the reservoir's construction, received accolades at the New England Arc/Info Users 2000 annual meeting. Participation in the Massachusetts Geographic Information Council's forum of GIS users provides the opportunity to share insights with professionals from across the state. Ongoing dialogue with MassGIS is critical to the success of this program.

Assessment

BWM's use of GIS technology offers vital support to staff and local municipalities, providing decision making tools, statistical analysis and map products to assist in forming and implementing management strategies and programs. The continued expansion, refinement and effective use of GIS capabilities are integral components of a comprehensive, well-reasoned approach to watershed management.

Control Approach

Goals

- To manage a Geographic Information System that provides the necessary data and analyses for the Bureau of Watershed Management to meet its water quality goals and regulatory requirements.

Objectives

- Maintain and update existing BWM specific data.
- Provide hardware and software to utilize geographic based data.
- Support BWM functions with GIS analyses and maps.
- Communicate effectively with MassGIS and other GIS users.

Action Items

- Update digital information, including all new BWM land purchases, Watershed Protection Act maps and parcels, and provide analyses for use in Bureau reports and publications.
- Continue support to municipalities and non-government organizations by providing GIS products and technical assistance.
- Continue to update the Wachusett Reservoir Watershed Land Acquisition Model to determine priority land for purchase.

8.4 Research Projects and Special Studies

Accomplishments:

- Continued commitment of staff time and funding for research on a variety of watershed issues including forest management, forest inventory, GIS Mapping, water quality, watershed and reservoir dynamics, stream gauging, watershed management methods and technologies, and wildlife populations.

Assessment:

It is important for watershed managers to keep up with developments in science and technology. Research provides tools for more efficient management and for improved response to ongoing changes in drinking water regulations. In addition, BWM is the steward for a unique resource that affords opportunity for many environmental research endeavors.

Key Actions:

- Support in-house research projects.
- Maintain an ongoing, cooperative research program between BWM and the University of Massachusetts, Amherst.
- Review requests by other institutions to participate in investigations of watershed issues.

Background

The BWM has a history of sponsoring research and special studies on a variety of watershed management issues. These research projects, on topics such as forest management, wildlife, and water quality, improved BWM's knowledge of the watershed system, its ecological processes, and management options.

Current Program and Accomplishments

Table 8-2 presents a summary of ongoing projects sponsored by the BWM in the Wachusett Reservoir watershed. BWM funded projects at the University of Massachusetts have subsequently led to two additional American Water Works Association Research Foundation (AWWARF) projects and a National Science Foundation project. The BWM has participated as a cooperating utility in additional AWWARF projects.

There are also several research initiatives led by BWM staff on water quality, forestry and wildlife topics. For example, over the last three years, Natural Resources staff have been monitoring wildlife resources on permanent plots. NR examines the small mammal, breeding bird, and reptile/amphibian community at each plot. The goal of this long-term monitoring program is to assess changes in these communities over time with respect to the land management activities that take place. The monitoring program is scheduled to continue indefinitely.

Assessment

The protected land holdings of the Wachusett Reservoir watershed are a special environmental system. It is important that the BWM keep abreast of advances in watershed management practice and general environmental science. The agency has established relationships with UMass, Amherst and the U.S. Geological Survey (USGS). Other institutions are also able to request the opportunity to scientifically investigate topics of mutual concern. The Bureau's commitment to watershed and general environmental research projects has furthered watershed protection efforts and staff professional development.

Control Approach

Goals

- To use knowledge obtained from research and special studies to continuously improve watershed management programs and obtain improved water quality.

Objectives

- Apply knowledge gained from research projects and special studies by developing specific watershed management practices.

Action Items

- Continue to support research projects and special studies by UMass (Indicator Organisms, Watershed Modeling, Watershed Runoff, Reservoir Modeling) and USGS (Stream Gauging)
- Continue to support in-house research projects and special studies, including In-situ Reservoir Water Quality Monitoring, Macroinvertebrate Monitoring, Forest Mapping and Wildlife Studies.
- Review requests by other institutions to participate in investigations of watershed issues.

Table 8-2
DCR/MWRA Watershed Research Projects

Project	Research Organization	Summary
In-situ Reservoir Water Quality Monitoring	BWM and MWRA	Install and maintain two in-situ (real-time) water quality monitoring buoys. The data are used to track the Quabbin interflow.
Macroinvertebrate Monitoring	BWM	Monitor populations of aquatic insects in order to evaluate water quality in tributaries.
Indicator Organisms	UMass	Assess watershed runoff for bacteria and pathogens; make recommendations about designing optimum water quality sampling program. Additional funding was procured for these studies from AWWARF.
Watershed Modeling	UMass	Develop methods to track sources of high fecal coliform bacteria in order to remediate. Additional funding was procured for these studies from AWWARF and NSF.
Watershed Runoff	UMass	Modeling to predict impacts of land use on organic and precursor export; watershed and tributary modeling to predict tributary water quality.
Reservoir Modeling	UMass	Modeling of in-reservoir processes that affect water quality; develop predictive capabilities.
Stream Gauging	USGS	Maintain network of stream and rain gages in watershed.
Wildlife Studies	BWM	Monitoring surveys to determine the utilization of habitat by particular species of wildlife in locations with forest management activities.

Source: DCR/DWSP/EQ and NR, 2003

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9 Implementation

The MDC Division of Watershed Management budget and staffing levels increased significantly from 1986 to 1998, including a period of severe reductions in both financial and staff resources during the Commonwealth's fiscal crisis of 1991-1994. After reaching a peak in budget and staff in 2000, there has been a steady reduction in financial and staffing resources. The Bureau of Watershed Management currently has 123 employees, including 57 professionals. This cadre of environmental professionals, supplemented by judicious use of consultants, has enabled BWM to maintain its excellent record of protecting the watershed system.

BWM is continually reexamining its priorities and capabilities in response to shifting resource levels. Fluctuations in watershed operations personnel have been affected by changes in the science and practice of watershed maintenance (e.g., shoreline mowing, cutting, access, aquatic mammal control) and the availability of mechanical equipment for operations previously done by manual labor. Irrespective of changes to financial and staff resource, BWM has continually been responsive to those operations and programs most directly impacting reservoir water quality and the delivery of water to the MWRA system that meets the water quality criteria specified in the Surface Water Treatment Rule.

Sections 9.1 and 9.2 respectively describe the organization and budget of the entire Division of Watershed Management. The Action Plan presented in Section 9.3 is exclusive to the Wachusett Reservoir Watershed.

9.1 *Organization and Staff*

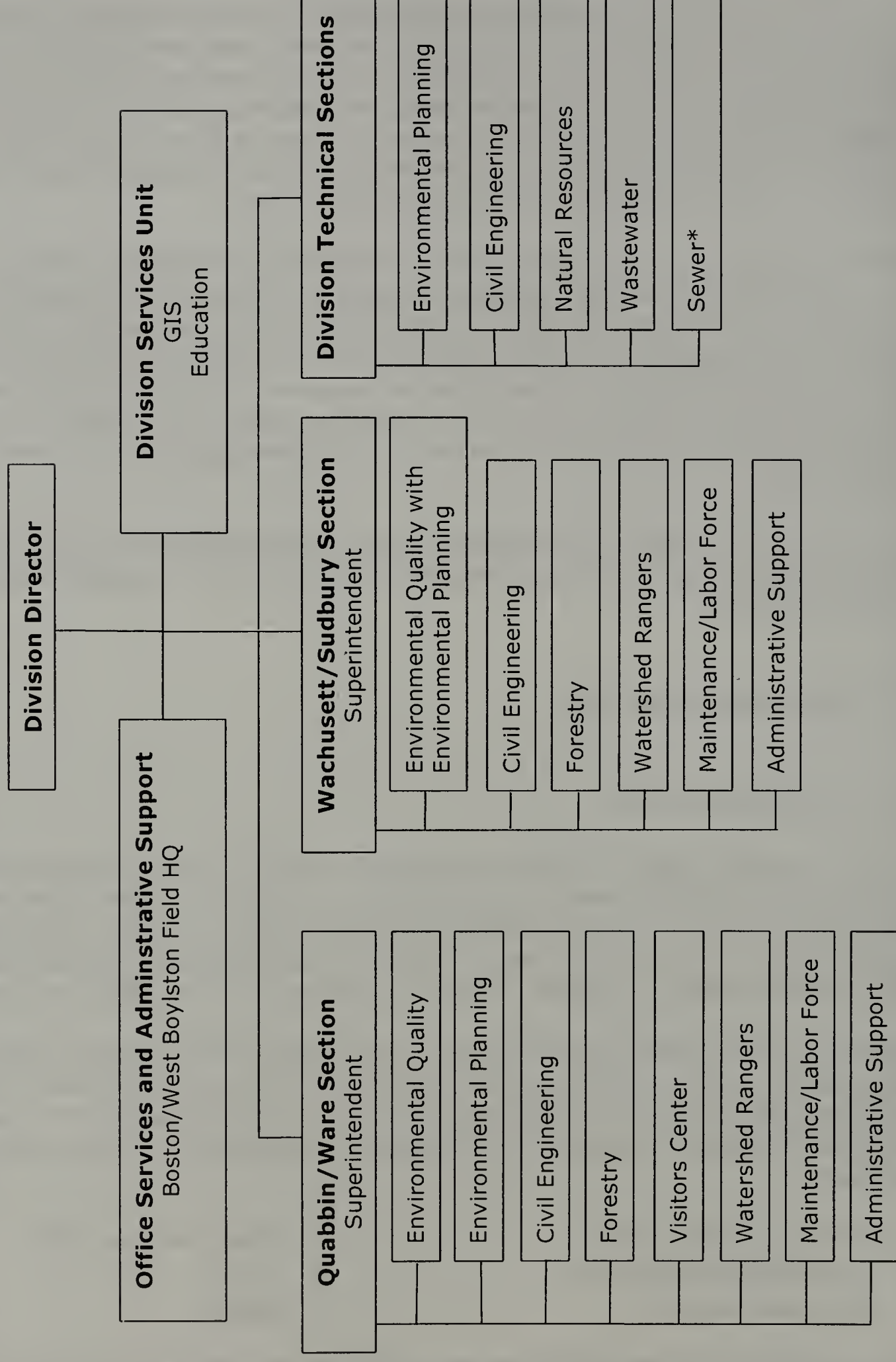
9.1.1 BWM Organization

The BWM currently employs 123 staff who perform a variety of duties in locations which range over 100 miles, from Boston west through the Wachusett Reservoir and Ware River watersheds out to the Quabbin Reservoir watershed. BWM staff include engineers, planners, wildlife biologists, aquatic biologists, foresters, bacteriologists, rangers, education specialists, skilled tradesmen, administrative assistants, accountants, bookkeepers, laborers and other skilled positions.

Figure 9-1 shows the BWM organization chart. Staff within BWM are organized into Administration, including service units that support the entire Bureau; the Division Technical Section, providing policy and planning support; and the field-based Quabbin/Ware Operations Section and Wachusett/Sudbury Operations Section. Within this structure, there are six core programs:

- Environmental Quality (EQ)
- Environmental Planning (EP)
- Civil Engineering (CE)
- Natural Resources (NR)
- Forestry
- Rangers

Figure 9-1: Bureau of Watershed Management Organization, FY04-FY08



* Includes five bond-funded, construction duration positions.

The EQ, EP, and CE programs are represented at both the BWM policy level and in the Operations Sections. The NR program is BWM level only, conducting land management and public access planning. The Forestry and Ranger programs are organized in the Operations Sections; staff in these programs coordinate extensively with BWM-level functions (EQ, EP, NR). The functions and activities of each unit are described in the following sections, as well as staff qualifications and training, as required by DEP Measures of Success. All field staff have been trained in the implementation of the Standard Operating Procedures (SOPs), established by the Bureau and approved by DEP, on subjects such as Building Demolition, Vegetative Waste Management, Vehicle Waste Disposal, and Illegal Dumping.

9.1.2 Administration

The Administration Section is responsible for specific support including procurement, contracting, and human resources, to all other BWM activities and sections. The Administration Section coordinates communication with all other DCR Divisions and departments (e.g., Human Resources, Payroll, Finance, Contract Administration, Labor Relations, Public Information, Commissioner's Office, Legislative Liaison, Office of General Counsel). The administration section is also responsible for coordination with other state, regional, and federal agencies.

There are two principal subunits within the Administration Section: the Office Services and Support Unit and the Division Services Unit. Office Services and Support represents primarily finance and office management staff, bookkeepers, clerks, and contract support. The Division Services Unit provides technical services to BWM staff and includes GIS and other MIS support functions (see **Section 8.3**), educational program support, and planning coordination.

9.1.3 Wachusett/Sudbury Operations and Quabbin/Ware Operations

The watershed system is managed at the field level within two major operations sections: the Wachusett/Sudbury Section and the Quabbin/Ware Section, each managed by the section Superintendent. Watershed operations sections embrace a multitude of functions throughout the watershed system. The operations section include staff representing the EQ, EP, and CE sections, as well as Forestry, Watershed Rangers, and labor crews. The operations labor forces include skilled laborers, skilled tradesman (carpenters, painters, welders, etc.), motor vehicle mechanics, heavy equipment operators, and requisite supervisory foremen and subforemen positions. Generally, the labor force is organized into crews with specific regional- and functional-assigned responsibilities.

The Wachusett/Sudbury and the Quabbin/Ware Operations Sections maintenance crews are responsible for:

- Participating in the bird harassment program, under the direction of EQ.
- Maintaining BWM facilities and equipment including:
 - fire roads
 - other roads and culverts

- buildings
 - grass cutting and related grounds keeping on dams and shorelines
 - vehicle fleet and heavy equipment
 - signs.
- Completing construction projects, such as erosion control BMPs.
 - Providing field support and assistance to other sections in the performance and maintenance of field projects.

Qualifications and Training

Training for operations staff includes implementation of Standard Operating Procedures, emergency boom deployment, boat safety, water safety (e.g., cold water rescue and survival), emergency response, fire suppression, bird harassment techniques, and erosion control practices.

9.1.4 Environmental Quality

Environmental Quality (EQ) is responsible for several major activities, such as remediation of pollution sources, monitoring, research, and technical review:

- Monitoring: EQ staff conduct all water quality monitoring of reservoirs and tributaries, including sampling and data analysis for NR, CE, and EP sections. Tasks range from sample collection, operation of analytical laboratories, and Environmental Quality Assessments (EQAs).
- Remediation: EQ staff oversee the gull harassment program, coordinate hazardous materials release responses, and employ BMPs to prevent, treat, and mitigate impacts of pollutants.
- Research: EQ is responsible for researching the sources, mobilization, transport, and fate of pollutants of concern to the water supply and the watershed system.
- Technical Review: EQ staff coordinate with local boards and commissions regarding enforcement of environmental regulations (e.g., Title 5, Wetlands Protection Act, Rivers Protection Act, WsPA, MEPA), conduct review of environmental impacts of proposed projects within watershed communities, and communicate with other state, federal and local agencies on a wide range of environmental matters of concern.

EQ staff represent the Bureau on a number of interagency committees, such as the Pathogen Control Working Group, Algae Task Force, and similar informal water quality and modeling science working groups. EQ has primary responsibility for the Bird Harassment Program (which is staffed by Operations Section labor and professional personnel under EQ direction).

EQ staff are responsible for maintaining water quality laboratories at the Bureau's Quabbin and Wachusett Reservoir field offices. The section is also responsible for securing and maintaining

contracts with qualified laboratories that perform analyses that cannot be conducted with BWM in-house capabilities. The MWRA and EQ routinely exchange data. EQ publishes reports on annual water quality, EQAs, and other water quality and environmental assessments (see Section 5).

Qualifications and Training

EQ staff hold degrees in environmental engineering, civil engineering, environmental science, biology, chemistry, and bacteriology. Four EQ staff are registered Professional Engineers. To remain current with emerging issues, staff participate in a wide variety of professional organizations and participate in conferences and training events. These include:

- Membership in American Water Works Association (AWWA), American Society of Civil Engineers, North American Lake Management Society (NALMS), New England Association of Environmental Biologists.
- Attendance at DEP training courses for Title 5, Rivers Protection Act, and Stormwater BMPs. All staff who review on-site wastewater disposal have received soil inspector and system inspector certifications.
- Participation in conferences sponsored by professional organizations on topics such as watershed protection practices, water quality testing methods, *Cryptosporidium*, erosion control practices, and BMPs for agriculture.

9.1.5 Environmental Planning

Environmental Planning (EP) was re-established in the Bureau in 1992, primarily in response to the additional administrative responsibilities placed on the Bureau pursuant to the passage of the Watershed Protection Act (WsPA; see Section 5.2.1). The section is primarily responsible for the administration and enforcement of the rules and regulations promulgated to regulate land use and development within the primary protection and secondary protection zones created by WsPA throughout the watershed system. The EP Section is also responsible for coordinating technical assistance to watershed communities with respect to planning, zoning, subdivision, and health bylaws specifically directed by WsPA. Due to the integrated nature of WsPA administration and other monitoring activities, the EP section at Wachusett/Sudbury has been integrated into the EQ section.

Qualifications and Training

All EP staff in the have degrees in planning or urban studies/affairs and have graduate degrees in planning and related fields. Staff are members of several professional organizations, including the American Planning Association (APA) and the American Institute of Certified Planners (AICP).

EP staff participate in training activities to stay informed about emerging issues relative to watershed protection. These include attending DEP training for stormwater, APA conferences, and Citizens Training Workshops.

9.1.6 Civil Engineering

Civil Engineering (CE) is responsible for the inspection, maintenance, repair, reconstruction, and analysis of all dams and appurtenant facilities, bridges, roads, and buildings under BWM's care and control. These facilities include 12 major water supply dams and related hydraulic structure, 14 bridges and 419 miles of roads and fire roads, and 65 individual buildings and facilities. In addition to the facilities themselves, such ancillary systems as water supply, wastewater disposal, heating and cooling, structural analysis, roofing, and historical preservation must be monitored and incorporated into the section's activities. The Engineering Section also is responsible for construction contract review and administration on major construction projects at BWM watershed facilities (see **Section 7.1**).

CE is responsible for maintaining and administering Emergency Action Plans (EAPs) pursuant to Federal Emergency Regulatory Commission (FERC) and MEMA requirements based on the classification of most of the water supply dams in this system as "large, high hazard" structures. This effort includes regular engagement of independent engineering structural evaluations; preparation and communication of Emergency Action Plans to federal, state, and local emergency agencies; and the conduct of standard telephone and operational drills of the EAPs at all facilities.

Qualifications and Training

Staff in the Civil Engineering Section hold degrees in civil engineering. Staff attend workshops and conferences on dam safety and other engineering subjects.

9.1.7 Natural Resources

Natural Resources (NR) is responsible for managing natural resources associated with BWM-owned watershed land and providing technical assistance to non-BWM landowners. Major activities within this section include coordinating forestry and land management plans (although the Operations Sections are responsible for conducting forestry management activities), wildlife management, developing plans and policies for public use and access to BWM lands and waters in the watershed, acquiring additional watershed lands considered critical for protection of the water supply, annual inspections of Conservation Restrictions held by the Bureau, and monitoring against encroachments and trespass on BWM lands (see **Section 4**).

NR conducts extensive research covering a broad range of issues related to the management and stewardship of forestry and wildlife resources, habitat management, ecosystem management, and biodiversity. This section also holds primary responsibility for the stewardship of historic and archaeological resources within the care and control of the Bureau.

Qualifications and Training

NR staff have degrees in forestry, wildlife biology, planning, landscape architecture, and civil engineering. Staff belong to many professional organizations including Society of American Foresters and the Wildlife Society. In addition to this, some staff are certified as foresters, arborists, and wildlife biologists. NR staff have attended conferences and professional training on such topics

as wetlands mapping, forest inventory methods, and identification and protection of rare species. NR hosts an annual symposium on forest management and watershed protection at the Quabbin Reservoir with 30 - 40 experts in the field, sponsored an international conference on watershed forest management in 1998, and attend the annual conference of the Northeast Association of Watershed Forest Managers.

9.1.8 Forestry

Each Operations Section is staffed by professional foresters. The Forestry staff is responsible for the annual planning, implementation, field oversight, and management of all forestry activity. In addition, foresters conduct field assessments and inventories of BWM forests and newly acquired lands, and contribute significantly to the development of long-term forest management plans. The NR Section coordinates a private lands stewardship program, through which private forest landowners are reimbursed for the cost of producing a 10-year forest management plan that qualifies them for Chapter 61 and/or Stewardship programs, including incentive practices.

Qualifications and Training

BWM Foresters have degrees in forestry; and many are members of the Massachusetts Association of Professional Foresters and the Society of American Foresters. Foresters regularly attend conferences and professional training sessions on such topics as: forest health, biodiversity, wildlife management, wildland firefighting and prescribed burning, and identification and protection of rare species.

9.1.9 Watershed Rangers

The Watershed Rangers are uniformed and trained primarily to maintain a positive, visual presence in the watershed, to observe the behavior of individuals engaged in activities on watershed lands and waters, and to ensure that such activities occur within the applicable rules through education and interpretive interaction with the public. Watershed Rangers are not responsible for criminal enforcement; when necessary, Rangers involve the State Police.

The Watershed Rangers also are a key element in the Bureau's education and outreach program. Their uniformed and enthusiastic presentations and demeanor work well with young, impressionable audiences both in classroom and on-site educational presentations. The Rangers will help to establish lifelong attitudes of respect and stewardship for the watershed's resources.

The Watershed Rangers' main activities are: patrol, field interpretive programs, and school-based programs. Since the terrorist attacks of 9/11/01, the emphasis of their work has been on patrolling and other security matters. The Watershed Rangers are assigned to one of the watersheds and report to the relevant Superintendent and to the Division Director.

Qualifications and Training

Personnel assigned to the Watershed Rangers come from a wide educational background. The Rangers have participated in intensive training and professional development courses, including:

- Interpretive Training Institute
- Project WET Training
- State Police Academy (Facilitating Communication in Difficult Situations)
- CPR/First Aid
- Search and Rescue
- Hazardous Materials Awareness
- Incident Command Systems
- Reservoir Spill Containment/Boat Operations.

9.1.10 MWRA Participation in Watershed Protection Activities

The MWRA Waterworks Division has played a significant role in watershed management since 1989, when MWRA and MDC hired Rizzo Associates to develop the first protection plans for the Quabbin/Ware and Wachusett watersheds. MWRA staff participate in a review capacity on all major projects. There are three on-going task forces between the two agencies – Reservoir Operations, Watershed Protection Act Working Group, and the Land Acquisition Panel; ad-hoc groups are organized as necessary on other topics of concern.

Shortly after the creation of the MWRA and the MDC Division of Watershed Management in 1985, a Memorandum of Understanding (MOU) was negotiated to establish the individual and shared responsibilities of these two new agencies. The MOU was first revised in 1993 in response to the original Watershed Protection Plans. Another revision is in process at the time of this Plan Update's publication. The MOU will continue to delineate the relationship between the DCR Bureau of Watershed Management and the MWRA.

9.1.11 Use of Consultants

The core staff of BWM is supplemented in expertise and resources by the use of consultants and universities for special assignment or when BWM needs to add specific skills. These consultants, engineers, scientists, and other professionals perform specific studies and/or tasks under contract. Research projects on topics such as forest management, wildlife, and water quality, such as those with the University of Massachusetts at Amherst, improve BWM's knowledge of the watershed system, its ecological processes, and management options. Professional engineering firms are utilized for specific studies and assessments, such as Rizzo Associate's *Hazardous Materials Emergency Response Plan*, SEA's design work on the Innovative/Alternative Septic System Technology Pilot Program, and CDM's *Wachusett Watershed Stormwater Management Plan*.

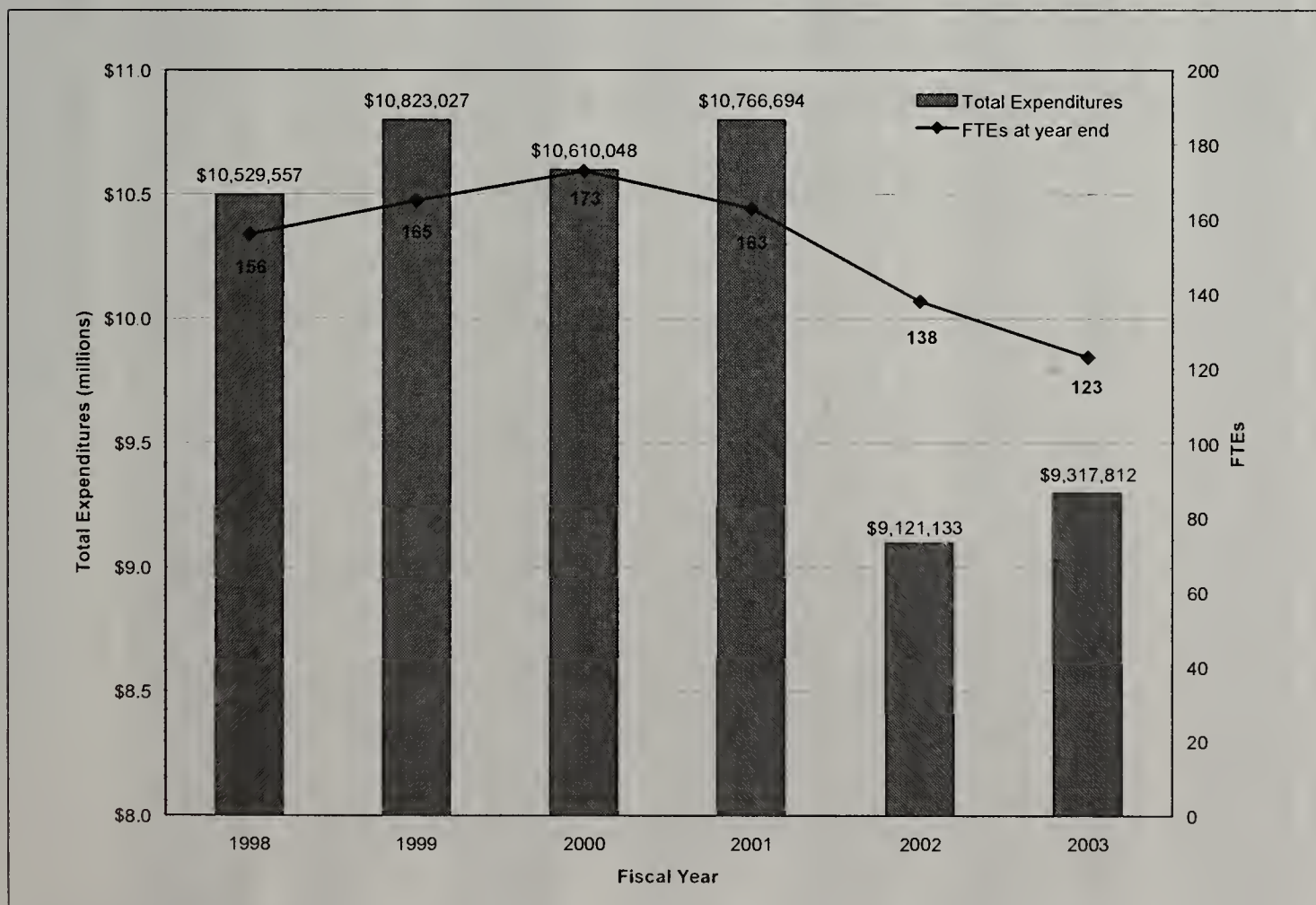
9.2 Budget

The annual operating budget for BWM is appropriated by the legislature as part of the state's annual fiscal budget process. MWRA reimburses the Commonwealth for 100% of the actual operating costs of BWM. MWRA also reimburses the Commonwealth for all debt service on capital projects and land acquisition, and funds the PILOT program to watershed and aqueduct communities. The BWM budget also includes an appropriation, separate from the MWRA cost assessment, for payment of sewage treatment costs to the town of Clinton.

Figure 9-2 shows the annual appropriations and staffing levels (measured in full time equivalents, or FTEs) for fiscal years 1998 through 2003, inclusive. Personnel costs typically account for over 70% of the operations budget. While the 1991 Plan suggested a staffing level of 185 FTEs to accomplish the recommended programs, BWM has managed to accomplish its objectives within the varying staffing levels reflected in Figure 9-2. This has largely been achieved through a continual effort of prioritizing in-house staff responsibilities and use of outside consultant services for specific projects and programs.

In addition, MWRA has several Waterworks Division staff people dedicating significant time to watershed protection planning activities and water quality monitoring. These MWRA efforts are closely coordinated with BWM.

Figure 9-2: BWM Total Expenditures and FTEs (FY1998-FY2004)



Source: DCR Finance Office, 2003

9.3 *Five-Year Plan*

BWM is committed to the provision of adequate staffing to successfully complete the wide variety of tasks involved in protecting the water supply and providing stewardship over the extensive system of land and water resources under its care and control. BWM's full implementation of the Watershed Protection Plans is directly attributable to the capabilities of its very qualified and dedicated staff.

To meet the needs of this Watershed Protection Plan Update over the next five years, BWM will be requesting approval to fill several vacancies in response to identified priority areas. These priority areas include the Environmental Quality Program in the Wachusett section; the Forestry Program in the Quabbin/Ware River section; and the operations labor forces in both the Wachusett and Quabbin sections.

MWRA and the Department of Conservation and Recreation are presently engaged in the negotiation of an updated Memorandum of Understanding. Important provisions relate to the annual budget planning process, including consideration for staffing levels and associated costs, based principally on the Watershed Protection Plans for both Wachusett and Quabbin Reservoirs. Building upon the current costs associated with personnel, it is projected that the staffing level of the DWM will need to increase to a level between 150 -165 FTE's, and an annual operating budget between \$10 and \$11 Million.

Table 9-1 presents a five year Action Plan generated from Sections 4 through 8 of this Plan. Unlike the previous Plan, this table does not demarcate an implementation timeline. Instead, each action is prioritized as either "High", "Medium", or "Low." This format provides the Bureau flexibility to achieve the most critical tasks. BWM will utilize the table as the basis for more detailed annual action plans used for both budgeting purposes and regulatory review.

Table 9-1
Wachusett Watershed Protection Plan Action Plan Summary

Task #	Description	Priority	Section
4.1 Land Acquisition Program			
1	Evaluate 1998 Land Acquisition Plan and assess whether it needs modification.	High	NR
2	Acquire control, through both in-fee acquisition and Conservation Restrictions, of highly rated land based on computer modeling and staff expertise.	High	NR
3	Work with EOEa and the Commonwealth Office of Development to partner with other conservation oriented entities to protect land in the Wachusett Reservoir watershed.	High	NR
4	Complete demolition, remediation and restoration of all property requiring such work.	High	NR
4.2.1 Public Access			
5	Continue Watershed Ranger program to improve voluntary compliance with the public access regulations through public education.	High	Rangers
6	Continue enforcement of public access regulations through partnership with the State Police, Environmental Police and local police departments.	High	Rangers
7	Improve key public access entry points in the watershed with signs, interpretive kiosks, appropriate parking facilities and gates.	Medium	Rangers
8	Develop and distribute Public Access Map(s) that show locations for hiking, bicycling, hunting, fishing, and parking.	Low	Rangers/ED
9	Provide public education and interpretive services through direct contact and printed materials.	Medium	NR/ED/ Rangers
10	Foster partnerships with local entities to develop and maintain facilities on BWM land in keeping with BWM policies and regulations.	Low	NR
11	Maintain a regular monitoring program for BWM forest roads, access points and reservoir shorelines.	Medium	Forestry
12	Implement Access Plan recommendations.	High	Super
13	Provide a yearly review of the Wachusett Reservoir Watershed Access Plan and, if necessary, a public meeting to gather input on implementation of the plan.	Low	Super
14	Update the Wachusett Reservoir Watershed Access Plan in 2008.	Medium	Super
4.2.2 Wildlife Control			
15	Continue Bird Harassment Program using all available and appropriate methods.	High	EQ
16	Continue to implement habitat modifications where appropriate.	High	NR

Task #	Description	Priority	Section
17	Continue beaver and muskrat control in the Aquatic Wildlife Pathogen Control Zone and when feasible initiate control in rest of reservoir; routinely evaluate the effectiveness of these controls.	High	NR
18	Monitor wildlife populations for presence of protozoa.	Medium	NR
19	Respond to complaints on beaver and beaver impoundments on DCR property impacting private land; provide assistance as time allows.	Medium	NR/EQ
20	Continue to locate all geese nesting on the reservoir and treat eggs to prevent hatching.	High	NR
4.2.3 Land Management			
21	Continue to conduct silviculture activities with the goal of forest diversity.	High	Forestry
22	Continue inspections to ensure compliance with BWM CMP forestry requirements for water quality protection.	Medium	Forestry/ NR
23	Continue to cut the reservoir shoreline on a rotational basis in order to encourage herbaceous and shrub species to dominate the shoreline.	Medium	Forestry/ Super
24	Write management plans for each parcel that the Bureau intends to maintain as a field.	Low	Forestry/ NR
25	Identify and provide habitat for rare flora and fauna in order to promote biodiversity and eliminate, and prevent where possible, the spread of non-native invasive species.	Low	Forestry/ NR
26	Continue to follow the objectives outlined in the Wachusett 10-year Land Management Plan, including approaches for newly acquired lands, forestry and management of fields and shoreline.	High	Forestry/ NR/ Super
27	Inspect BWM property bounds to identify encroachments.	Medium	Forestry/ NR/ Rangers
28	Conduct outreach with abutters of BWM lands to inform them of BWM property bounds and allowable uses of BWM lands.	Medium	NR/ Super/ Rangers
4.3 Other Protected lands			
29	Perform baseline surveys on all CR purchases.	High	NR
30	Monitor all of the Bureaus CRs.	High	NR
31	Pursue care and control agreements with other state agencies and non-profit land protection organizations.	Low	NR
32	Monitor Chapter 61 properties to encourage more permanent forms of protection.	Low	NR
5.1.1 Watershed Water Quality Monitoring			
33	Continue routine and non-routine water quality sampling and biological monitoring in the watershed.	High	EQ
34	Complete a five-year update to the report by BWM focusing on ten years of fecal coliform bacteria and conductivity data on the Wachusett tributaries, which will further refine BWM's ability in establishing priorities among watershed programs and subbasins.	Medium	EQ
35	Continue use of stream gages to measure stream flow.	High	EQ

Task #	Description	Priority	Section
36	Continue to work with UMass to refine use of alternative source-specific indicators to help discriminate sources of microbial contamination.	Medium	EQ
37	Focus efforts on stormwater sampling to improve understanding of primary external source of reservoir contamination.	High	EQ
5.1.2 Reservoir Water Quality Monitoring			
38	Continue routine and non-routine water quality sampling (including plankton monitoring) in Wachusett Reservoir.	High	EQ
39	Continue macrophyte control efforts to stop the spread of Eurasian Water-milfoil in the reservoir and to reduce the source population in the Stillwater Basin.	High	EQ
40	Complete and utilize water quality model to assist with reservoir operations decisions.	Medium	EQ
41	Continue to coordinate the Reservoir Operations Group.	Medium	Super
5.2.1 Watershed Protection Act			
42	Continue to administer individual applications under the Watershed Protection Act regulations. Review all WsPA applications, respond in a timely manner and track WsPA applications.	High	EQ/Plan
43	Continue to convene the Watershed Protection Act Working Group.	Medium	Plan/EQ
44	Refer development projects not regulated by the WsPA for appropriate review and tracking under other statutory authority by Environmental Quality Section staff.	High	EQ
45	Update parcel information in the GIS database.	Medium	Plan/GIS/EQ
5.2.2 Other Environmental Regulations			
46	Continue to meet, as necessary, with DEP, DAR, EPA and other agencies to enforce compliance with existing environmental regulations.	Low	EQ/Super/Plan
47	Review DEP Enforcement Protocol.	Medium	EQ/Super/Plan
48	Continue to monitor cases through EQ and WsPA tracking system.	High	EQ
49	Continue to screen for potential violations through ongoing water quality monitoring, environmental quality assessments, and field surveillance.	High	EQ
5.3 Environmental Quality Assessments			
50	Maintain five-year cycle/rotation for completion of Environmental Quality Assessments.	High	EQ
51	Implement recommendations for completed EQAs.	High	EQ
52	Produce annual status report on all recommendations in past EQAs.	Medium	EQ
6.1.1 Sewers			
53	Complete Final Phases of sewer project in Holden and West Boylston.	High	Sewer

Task #	Description	Priority	Section
54	Track connections to new sewer lines.	High	Sewer
55	Implement Worcester sewer system improvements.	High	Sewer
56	In conjunction with routine water quality monitoring, assess impact of sewers on water quality.	Medium	EQ
57	Assist Rutland and Holden with Infiltration/Inflow (I/I) Reduction Programs.	High	Sewer
58	Evaluate I/I and sewer condition of BWM Rutland-Holden trunk sewer.	High	Sewer
6.1.2 On-Site Treatment			
59	Continue to review routine water quality data for any evidence of potential problems with on-site systems.	High	EQ
60	Review local records, water quality data, and other pertinent information in conducting Environmental Quality Assessments to identify potential problem sites or areas.	High	EQ
61	Provide assistance, as requested, to local boards of health on wastewater disposal issues, such as alternative technologies, septic system O&M, and local and regional management alternatives.	Medium	EQ/Sewer
62	Continue to monitor Alternative/Innovative systems installed in BWM pilot program.	Low	Sewer
63	Utilize Septic Database System to develop statistics based on subbasin, type of system and age, as well as information pertaining to problems, repairs, and Title 5 replacements.	Low	Sewer
6.2 Stormwater Management			
64	Add additional stormwater sampling. Continue work with UMass to collect stormwater samples after hours.	High	EQ
65	Add additional stormwater sampling specific to evaluate BMPs (before and after installation).	Medium	EQ
66	Develop revised list of projects for the 2004 – 2009 timeline that integrates water quality and resource considerations. Install one new BMP each year for next five years.	High	EQ
67	Review MHD Phase II permit and meet to coordinate with appropriate MHD staff.	Medium	EQ
68	Assess research needs relative to stormwater modeling and monitoring.	Medium	EQ
69	Work with MHD specifically on I-190 basin maintenance.	Medium	EQ
70	Work with local towns to assist in implementing the required Phase II Pollution Prevention Plan.	High	EQ
71	Provide technical assistance to towns, as requested, on issues such as stormwater bylaws.	Medium	EQ
72	Complete stormwater mapping for major conveyance structures in the watershed.	High	EQ
6.3.1 Highways and Railroads			
73	Coordinate efforts with State and local highway departments and railroad companies to improve operational and maintenance practices.	Low	EQ
74	Advocate for State and local highway departments to include Best Management Practices (BMPs) into new construction or improvements of existing roads in order to treat or redirect all direct discharges to the reservoir.	Medium	EQ

Task #	Description	Priority	Section
6.3.2 Hazardous Materials Emergency Planning and Response			
75	Refine participants and responsibilities in the Hazardous Materials Emergency Response.	Medium	Super
76	Promote training and equipping of BWM staff and local responders. Coordinate drills and communications to maintain and improve cooperation among State and local responders.	Medium	EQ/Rangers
77	Prepare and maintain plan for BWM property response priorities, and assist communities with update and preparation of their Comprehensive Emergency Response Plans.	Medium	EQ/Rangers
78	Coordinate with active railroad companies on security and freight issues within state and federal guidelines.	Low	Director
6.4.1 Construction (Erosion and Sediment Control)			
79	Continue to review projects through WsPA, working with conservation commissions and other local boards.	High	EQ
80	Monitor active projects through on site inspections and water quality testing.	High	EQ
81	Pursue compliance and enforcement of all appropriate environmental regulations.	Medium	EQ/Super
6.4.2 Agriculture			
82	Monitor agricultural impacts through EQAs; follow policy to contact agricultural land owner if there is a violation of watershed regulations.	High	EQ
83	Update status of sites identified as most important in 1998 Plan. Evaluate effectiveness of installed BMPs.	Low	EQ
84	Identify and locate new hobby farms.	Low	EQ
85	Assess opportunities to educate hobby farm and nursery/landscape operators on water quality issues.	Low	EQ
86	Coordinate with DAR and EOEa to integrate water quality objectives into their agricultural outreach materials.	Low	Plan/EQ/ Super
6.4.3 Private Forestry			
87	Renew the three year contract for private lands stewardship assistance.	Medium	NR
88	Continue to review all forest cutting plans that occur in the watershed.	Medium	Forestry
7.1 BWM Facilities			
89	Complete underwater inspections of Wachusett Dam and Cosgrove Intake Facility; develop necessary repair designs from inspections.	High	Director/CE
90	Proceed with Spillway improvements and North Dike modifications.	Medium	Director/CE
91	Install specialized instrumentation and sensing devices at Bureau dams.	Medium	Director/CE
92	Revise, as necessary, the Emergency Action Plan.	High	Director/CE/ MWRA

Task #	Description	Priority	Section
93	Coordinate with MWRA on future infrastructure maintenance and improvement activities in order to minimize and mitigate any impacts on water quality and water treatment.	Medium	Director/CE/ Super
7.2 Security			
94	Due to the sensitive nature of this matter, specific details are not included.		
8.1 Community Technical Assistance/			
95	Maintain communication with boards of health, conservation commission, planning boards, public works departments and boards of selectmen.	Medium	EQ/Super
96	Provide direct technical assistance support, as requested, to local boards and community organizations.	Low	EQ
97	Administer existing Technical Assistance contracts.	Low	Plan/EQ
98	Implement Technical Assistance Contract Program to strengthen local planning capability.	Low	Plan/EQ
99	Track changes in local bylaws for watershed protection through regular communication with towns and Regional Planning Agencies.	Low	EQ
8.2 Public Education and Community Outreach			
100	Continue to develop, implement, and expand curriculum developed for the Wachusett Regional School District.	Low	ED
101	Continue to manage Project WET and support other state environmental programs including Project WILD, Project Learning Tree and the Envirothon.	Low	ED
102	Continue to offer in-school and field programs to watershed school systems.	Low	Rangers
103	Develop programs and exhibits at Stillwater Farm.	Low	ED
104	Expand use of kiosks and bulletin boards to educate visitors.	Medium	Rangers
105	Prepare outreach materials for the general public and media on DCR and general watershed topics.	Low	Super/ED/ Rangers/NR/P lan
106	Continue to develop website to provide educational resources on watershed management topics.	Low	Plan
107	Continue publication of the Downstream newsletter. Assess topics and distribution process.	Low	NR/Super/ Plan
8.3 Geographic Information Systems			
108	Update digital information, including all new BWM land purchases, Watershed Protection Act maps and parcels, and provide analyses for use in Bureau reports and publications.	High	GIS
109	Continue support to municipalities and non-government organizations by providing GIS products and technical assistance.	Low	GIS

Task #	Description	Priority	Section
110	Continue to update the Wachusett Reservoir Watershed Land Acquisition Model to determine priority land for purchase.	Low	GIS
8.4 Research Projects and Special Studies			
111	Continue to support research projects and special studies by UMass (Indicator Organisms, Watershed Modeling, Watershed Runoff, Reservoir Modeling) and USGS (Stream Gauging)	Medium	EQ
112	Continue to support in-house research projects and special studies, including In-situ Reservoir Water Quality Monitoring, Macroinvertebrate Monitoring, Forest Mapping and Wildlife Studies.	Medium	EQ/NR/ Forestry
113	Review requests by other institutions to participate in investigations of watershed issues.	Low	Super/EQ/ NR

KEY:

CE: Bureau Civil Engineering Section
 Director: Division Director
 ED: Bureau Education Section
 EQ: Wachusett Environmental Quality Section
 Forestry: Wachusett Forestry Section

NR: Bureau Natural Resources Section
 Plan: Bureau Planning Section
 Rangers: Wachusett Watershed Rangers
 Sewer: Bureau Sewer Section
 Super: Wachusett Superintendent

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Appendix A: DEP's Programmatic Milestones and Measures of Success and BWM Watershed Protection Plan Accomplishments and Activities

The Massachusetts Department of Environmental Protection Division of Water Supply published in April, 1996 the "Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Suppliers to Obtain, and Maintain a Waiver from Filtration." This document specifies DEP's process for assessing requests for filtration waivers and criteria – termed "programmatic measures" – to measure the success of the water supplier's watershed management efforts. BWM and MWRA successfully met this criteria in 1998; this table presents only those criteria necessary to maintain a waiver from filtration.

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
1. Watershed Control				
a.	Present evidence to DWS during annual inspection that land use protection measures which have been enacted to address HIGH, MEDIUM, LOW impact activities are working to reduce impacts (i.e., through a description of the regulatory authority's procedures for reviewing proposed developments; summary of projects approved since the last annual inspection, etc.).	Documentation available at BWM offices	BWM's implementation of the various land use controls in its Watershed Protection regulations (350 CMR 11.00) provides extensive watershed protection from certain land use activities within private lands and waters and on BWM managed lands and waters in the watershed. BWM staff specifically reviews all development activities falling within the WsPA's protection zones according to the regulations. BWM staff regularly communicate with local boards (e.g., conservation commission) to support local land use controls. BWM maintains a library of all watershed town bylaws.	5.2.1
b.	Provide evidence to water supplier input to local regulatory review processes.	Documentation available at BWM offices	BWM fund studies and contributes technical expertise to revise watershed town subdivision by-laws. BWM staff provide regulatory and technical input to local boards (e.g., BOH or conservation commission).	8.1
c.	Provide copies of any changes in local zoning regulations affecting water supply protection to DWS during the annual on-site inspection.	Documentation available at BWM offices	BWM maintains a library on all watershed towns' bylaws, with a focus on those related to land use activities such as subdivision/residential development and earth removal.	5.2.1, 8.1

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
d.	Provide evidence of regular watershed inspections to monitor effectiveness of protection measures and to identify new impacts to source.	Documentation available at BWM offices	BWM's expansive water quality monitoring and Environmental Quality Assessment programs monitor the effectiveness of the watershed protection program, existing land use controls, and ensure that any new water quality impacts are quickly identified and remediated. BWM also conducts target monitoring aimed at assessing the effectiveness of specific protection measures.	5.1, 5.3
e.	Provide evidence that newly identified impacts have been adequately addressed through land acquisition, deed control, or other protection measures.	Documentation available at BWM offices	There are very few land use activity impacts in the Wachusett Reservoir watershed as evidenced by water quality data. These are limited to roosting gulls, addressed by the gull control program. BWM has various programs in place to adequately control newly identified impacts. These programs include land acquisition, where necessary to halt a significant problem, as well as targeted areas such as development, public access, wildlife, agriculture, wastewater disposal, storm water, rights-of-way, contaminated site, emergency situations, construction, gravel mining.	2.4, 4 - 8
2. Public Access/Recreation				
a.	Provide evidence of implementation of management plan.	Documentation available at BWM offices	BWM has implemented the key components of the Wachusett Public Access Plan, including: maintenance of allowed and prohibited activities and areas, supporting the Watershed Ranger Program, and installing signs (gate, trail, and informational kiosks).	4.2.1
b.	Provide evidence (logbook) of sufficient inspections on water supplier-owned lands to monitor public use; enforcement of rules and resolution of violations.	Documentation available at BWM offices	Watershed Rangers keep daily logs of public's use and activities on BWM lands and waters. Watershed Rangers continue to enforce public access regulations, in partnership with State Police, EPOs, and local police departments. The Chief Ranger compiles statistics from each ranger's logbook each month.	4.2.1
c.	Show proper upkeep and management of water supplier-owned lands.	Meets	BWM has an acclaimed forestry program, aimed at increasing forest diversity to protect long-term water quality.	4.2.3
d.	Update public access/recreation plan as needed.	Meets	BWM updated the Wachusett Public Access Plan in 2003. BWM will update these plans as needed.	4.2.1
3. Wildlife Management				
a.	Present evidence (logbook) of regular inspections for wildlife impacts and address/eliminate impacts as needed.	Documentation available at BWM offices	BWM's wildlife biologist maintains records of all sightings, surveys, and actions (including animal removals).	4.2.2

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
b.	Continue conducting water quality monitoring program to assess wildlife impacts.	Meets	BWM's water quality monitoring is designed to capture all potential pollution sources, including wildlife sources. Specifically, monitoring of tributaries and in-reservoir sampling within the Pathogen Control Zones, serve to identify possible wildlife impacts. In addition, research and development of emerging laboratory methods for analyses is being conducted by UMass for BWM.	5.1
c.	Update management plan as needed.	Meets	The <i>Wachusett Reservoir Watershed Land Management Plan: 2001 – 2010</i> was adopted in August, 2001. BWM will update its management goals, objectives, and activities as needed.	4.2.3
d.	No disease outbreaks associated with wildlife.	Meets	There are no known waterborne disease outbreaks associated with the Metropolitan Boston water system.	5.1
4. Infrastructure Improvements				
a.	Verify no new impacts to source from municipal activities/facilities.	Meets	BWM's extensive water quality monitoring program, Environmental Quality Assessment program, Watershed Protection Act administration, and community technical assistance, monitor and ensure no new impacts from municipal activities.	5, 8.1
b.	Provide evidence that infrastructure maintenance and improvements are proceeding per schedule.	Documentation is available at the BWM and MWRA offices.	BWM makes regular and systematic infrastructure inspections	7.1
c.	Provide evidence of additions to schedule, as needed.	Meets	BWM will update schedules as needed.	7.1
d.	Provide evidence of continued inspections, maintenance, and repairs to water supply intake and any dams, and that pump-house continues to be secured against unauthorized entry.	Documentation is available at MWRA offices.	MWRA and BWM have ongoing maintenance programs in place.	7
5. In-lake Problems				
a.	Maintain lake health; provide evidence of continued regular inspections and log of monitoring data.	Meets	BWM's water monitoring program is on-going. BWM conducts annual planning of most programs.	2.4, 5.1, 5.3

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
b.	Provide evidence of addressing any new or recurring problems in a timely manner.	Meets	BWM was able to address in-lake impacts from roosting birds	4.2.2
c.	Adjust monitoring locations as needed.	Meets	BWM adjusts locations as needed, conducting annual planning of the monitoring program. In addition, special studies are done to supplement routine monitoring.	5.1, 5.3
6. Sampling				
a.	Continue to meet all sampling requirements outlined in 310 CMR 22.00 and in the Watershed Protection/Control Program.	Meets	MWRA and BWM water quality sampling is ongoing. MWRA conducts regulatory source water quality monitoring at the intakes in accordance with 310 CMR 22.00 and the IESWTR. BWM conducts routine regulatory water quality monitoring throughout the watersheds and reservoir.	5.1
b.	Show, through monitoring and trend analysis, no degradation of water quality.	Documentation is available at BWM offices.	Since BWM began extensive watershed protection program which included enhanced water quality monitoring, the data indicates that reservoir water quality has improved or stayed the same. BWM publishes annual water quality reports to integrate the extensive data collected in the watersheds and reservoir.	2.4
7. System Operation/Maintenance				
a.	Update management and operating procedures.	Documentation at MWRA offices.	MWRA updates its procedures as needed.	7
b.	Update inspection and maintenance program as needed.	Documentation at MWRA offices.	MWRA updates its C & M program as needed.	7
c.	Maintain repair log.	Documentation at MWRA offices.	MWRA maintains its repair log.	7
8. Staffing				
a.	Continue to show sufficient and qualified staff, or are on-schedule with meeting those needs.	Meets	DWM expanded its staff significantly following the 1991 plan. Several additional positions (currently vacant or new) are planned in the 5-year period.	9
b.	Document that training schedule is being met.	Documentation available at BWM offices.	BWM provides ongoing training for its staff using conference seminar attendance, in-house training, and specialized training from other state agencies (e.g., DEP).	9

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
c.	Show that water supply operation and maintenance continues to be carried out by qualified individuals.	Documentation available at MWRRA offices.	MWRA operators at the Cosgrove Intake hold required certification and are well trained. BWM staff are well qualified, representing various professional degrees and certifications.	7, 9
d.	Have provided water supply reference and training materials for staff use.	Meets	BWM has a large library of watershed protection and management documents. The MWRA library also serves as a reference resource for BWM staff.	9
9. Emergency Planning/Response				
a.	Conduct annual water supply-related drill and provide write-up, noting problems and corrective actions (coordinate with other towns in watershed, if applicable).	Meets	BWM staff completed an emergency response program with a planned water supply related response drill in collaboration with local and state agency personnel. MWRA has completed several emergency drills in conjunction with other agencies.	6.3.2, 7.2
b.	Review and update plan annually.	Meets	BWM will review its response programs annually and update as needed.	6.3.2, 7.2
c.	Inspect watershed for conditions conducive to spills/accidents; remove or control problem where possible.	Meets	BWM prepared the Transportation Release Controls Study, has prioritized the recommendations, and is implementing strategies to reduce the risk of accident or spill.	6.3.2, 7.2
d.	Maintain contact with high impact land users upstream.	Meets	BWM has inventoried underground storage tanks (UST), working with local fire departments during removal. BWM monitors DEP's database of hazardous materials generators and past releases. DEP and local fire departments notify BWM in case of a spill.	6.3.2
e.	Maintain signs.	Meets	BWM posts and maintains numerous signs along property boundaries, access gates and barways, and popular stops throughout the watershed. (Section 4.3).	4.2.1
f.	Conduct at least one emergency response-related event from educational program annually.	Meets	Education program incorporates many different elements, including spills/emergencies.	6.3.2, 8.2
10. Education/Multi-town Coordination				
a.	Provide evidence of implementation of educational programs, conduct at least one major educational seminar yearly.	Meets	Watershed Rangers have presented approximately 200 school programs. From 1998 to 2003, the Bureau has held 122 workshops, training 1,757 teachers to use Project WET materials.	8.2
b.	Review and update programs annually, at minimum.	Meets	BWM updates its education programs annually.	8.2

Item	DEP's Measures of Success to Maintain a Waiver	Status	BWM's WPP Accomplishments and Activities (Summarized)	WPP Section
c.	Provide evidence of continued exchange of maps, updated plans, and new/updated local regulations/bylaws, where applicable.	Documentation available at BWM offices.	BWM provides updated WsPA maps to towns upon request. Public Access maps are available upon request and are also posted on the Bureau's website. The Bureau, through its Technical Assistance program, has sponsored the development of community Master Plans and Public Access Plans.	5.2.1, 8.1, 8.2
d.	Hold public forum for local officials and staff at least once per year to discuss water supply-related issues; for multi-town watersheds: invite local officials and staff from other towns.	Meets	Public meetings were held to discuss the Wachusett Reservoir Watershed Land Management and Public Access Plans.	4.2.1, 4.2.3, 9
e.	Where regional water supply, new protection committees have been established, provide evidence of regular meetings and activities.	Documentation available at BWM offices.	WSCAC meetings are held regularly. The Watershed Advisory Group has been consulted in the development of all Bureau Plans.	9
f.	Where regional water supply, new project notification process has been established, provide evidence of project review.	Documentation available at BWM offices.	BWM has access to and utilizes the opportunity to comment on state and local permit applications.	5.2

Appendix B: Watershed Protection Regulations (350 CMR 11.00)

WATERSHED PROTECTION REGULATIONS

350 CMR 11

Division of Watershed Management, Metropolitan District Commission
with corrections, May, 1994

Section

- 11.01: Introduction and Purpose
- 11.02: General Provisions
- 11.03: Definitions
- 11.04: Jurisdiction
- 11.05: Exemptions
- 11.06: Procedures
- 11.07: Maps
- 11.08: Relationship of Act with other State and Municipal Statutes, Ordinances and Regulations
- 11.09: General Rules and Regulations for the Protection of Watersheds and the Watershed System
- 11.10: Enforcement
- 11.11: Miscellaneous
- 11.12: Severability
- 11.13: Forms

11.01 Introduction and Purpose

(1) Introduction - 350 CMR 11.00 is promulgated by the Commissioners of the Metropolitan District Commission pursuant to the authority granted under St. 1992 c. 36. St. 1992 c. 36, 2 amends M.G.L. c. 92, 104 by adding certain definitions which are used in 350 CMR 11.03; St. 1992 c. 36, 3 adds M.G.L. c. 92, 107A defining the jurisdiction and exemptions contained in 350 CMR 11.04 and 350 CMR 11.05, respectively; and St. 1992 c. 36, 4 amends M.G.L. c. 92, 108 by requiring the Division of Watershed Management, after consultation with the Department of Environmental Protection, to make rules and regulations for the protection of Watersheds as defined in St. 1992 c. 36.

In addition, St. 1992 c. 36 and M.G.L. c. 92 authorize the Metropolitan District Commission and the Division of Watershed Management to make rules and regulations to protect the Watersheds as defined in St. 1992 c. 36 and the Watershed System as defined in St. 1992 c. 36 and M.G.L. c. 92. The Department of Environmental Protection is also required under St. 1992 c. 36, 14 to adopt rules and regulations for the prevention of pollution and securing the sanitary protection of all waters used as sources of water supply in the Commonwealth other than in the Watersheds as defined in St. 1992 c. 36. Regulations currently exist for:

- (a) the sanitary protection of waters used by the Metropolitan District Commission (310 CMR 23.00);
- (b) land within Watershed Reservations (350 CMR 8.00);
- (c) sanitary rules and regulations for the Metropolitan Water Supply (350 CMR 9.00); and
- (d) fishing in Wachusett and Sudbury Reservoirs (350 CMR 10.00).

In order to facilitate review of all regulations promulgated by the Metropolitan District Commission and the Division of Watershed Management relating to Watersheds and the Watershed System, 350 CMR 11.09 includes regulations of general applicability to Waters of the Watershed System. The regulations in 350 CMR 11.09 are intended to supersede the regulations in 310 CMR 23.00, 350 CMR 8.01, 350 CMR 9.00, and 350 CMR 10.00, which shall be repealed on March 31, 1994.

(2) Purpose - The purpose of St. 1992 c. 36 is to improve the protection of the metropolitan water supply. St. 1992 c. 36 and 350 CMR 11.00 set forth a comprehensive scheme to regulate land use and activities within certain critical areas of the Watersheds and Watershed System.

The purpose of 350 CMR 11.00 is to define and clarify the restrictions and prohibitions set forth in St. 1992 c. 36 by establishing standard definitions and procedures under which the Division of Watershed Management may carry out its responsibilities under St. 1992 c. 36. 350 CMR 11.00 shall complement St. 1992 c. 36 and shall have the force of law on March 31, 1994.

11.02: General Provisions

(1) Time Periods. Unless otherwise specifically provided in St. 1992 c. 36 or 350 CMR 11.00, computation of any time period referred to in 350 CMR 11.00 shall begin with the first day following the action which initiates the running of the time period. The last day of the time period so computed is to be included unless it is a Saturday, Sunday or legal holiday or any other day on which the office of the Division is closed, in which event the period shall run until the end of the next following business day. When the time period is less than seven days, intervening days when the Division is closed shall be excluded in the computation.

(2) Timely Filing. All Papers must be filed at the Division office or such other place as the Division shall specify in 350 CMR 11.00 within the time limits set forth herein.

Unless otherwise specifically provided in St. 1992 c. 36 or 350 CMR 11.00, Papers filed in the following manner shall be deemed to be filed as set forth herein:

(a) *Hand delivery during business hours*. By hand delivery during business hours shall be deemed filed on the day delivered.

(b) *Hand delivery during non-business hours*. By hand delivery at times other than during regular business hours shall be deemed filed on the next regular business day.

(c) *Mailing*. By placing in the United States Mail certified or registered mail, return receipt requested shall be deemed filed on the date received by the Division.

All Papers shall show the date received by the Division and the Division shall cooperate in giving date receipts to Persons filing Papers by hand delivery.

(3) Actions by the Division. Where St. 1992 c. 36 states that a particular action (except receipt of a request or notice) is to be taken by the Division, that action is to be taken by the person designated by 350 CMR 11.00 or, if by a committee, by more than half the members present at a meeting of at least a quorum. A quorum is defined as a Majority of the members then in office.

(4) Burden of Proof. Any Person who files a request for Advisory Ruling, a request for Watershed determination of applicability, an application for variance or a request for Exemption of a Tributary shall have the burden of producing credible evidence from a competent source in order to demonstrate to the Division or, in the case of an appeal, to the Commission, support for the position taken or the relief requested.

(5) Capitalized Terms. Any capitalized terms used in 350 CMR 11.00 shall have the meanings ascribed to such terms in 350 CMR 11.03.

11.03 Definitions

Advisory Ruling means a ruling issued by the Division pursuant to 350 CMR 11.06(1).

Agriculture, Land in Agricultural Use and Normal Maintenance or Improvement of Land in Agricultural Use shall have the meanings ascribed to such terms in 310 CMR 10.04.

Alteration means:

(a) draining, dumping, dredging, damming, discharging, excavating, filling or grading;

11.03: continued

- (b) the erection, reconstruction or substantial expansion of any buildings or Structures;
- (c) the driving of pilings;
- (d) the construction or reconstruction or paving of roads and other ways;
- (e) the construction or reconstruction of utilities;
- (f) the changing of run-off characteristics;
- (g) the intercepting or diverting of ground waters, surface waters, reservoirs, tributaries, or aquifers; and
- (h) the installation or substantial expansion of drainage, sewage and water systems.

Applicability Decision means the written decision issued by the Division pursuant to 350 CMR 11.06(2)(e).

Aquifer means a geological formation, group of formations, or part of a formation in the Wachusett Watershed that is capable of yielding a significant amount of water to a well or spring, as determined by reference to the Maps, 350 CMR 11.07. The land directly overlaying an aquifer shall be deemed to be part of said aquifer.

Authority means the Massachusetts Water Resources Authority.

Bank means the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a Bordering Vegetated Wetland and adjacent Flood plain, or in the absence of these, it occurs between a water body and an upland. A bank may be partially or totally vegetated or may be comprised of exposed soil, gravel or stone. The upper boundary of a bank is the first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a bank is the mean annual low flow level.

Bordering Vegetated Wetland means a wet meadow, except meadows used for the grazing of livestock, marsh, swamp, bog or other area, hydrologically connected to and bordering on a Tributary, Reservoir, Flood plain, or Surface Water, which supports at least 50% wetland species and as defined in the Wetlands Protection Act as defined herein.

Commission means the Metropolitan District Commission.

Commonwealth means the Commonwealth of Massachusetts.

Date of Issuance means the date a determination, order or decision is hand delivered or mailed as provided in 3. CMR 11.00.

Date of Submission means the date the Division assigns a file number to a request or application submitted pursuant to 350 CMR 11.06. Assignment of a file number shall not imply that a request, application or supporting documents have been determined adequate to support the relief requested, but only that the submission is complete in accordance with the requirements of 350 CMR 11.06.

Department means the Department of Environmental Protection of the Commonwealth of Massachusetts.

Discharge or Discharge of Pollutant means any addition of Pollutants or combination of Pollutants from any source including, but not limited to, discharges from surface runoff, which are collected or channelled by man and through pipes, sewers or other conveyances.

11.03: continued

Disposal means the discharge, deposit, injection, dumping, spilling, leaking, incineration or placing into or on any land or water so that the matter disposed of may enter the environment or be emitted into the air or discharged into any waters, including Ground water.

Division means the Division of Watershed Management of the Commission.

Dwelling means any structure or building, or any portion thereof which is used, intended to be used, or designed to be occupied for human habitation purposes, including, but not limited to, houses, hotels, motels, apartments and condominiums.

Exemption Decision means a decision of the Division, in consultation with the Department, to exempt a Tributary from regulation under St. 1992 c. 36 issued pursuant to 350 CMR 11.06(4)(g).

Flood plain means the land adjoining a Tributary, Reservoir or Surface Water, which is subject to inundation from a flood having a 1% chance of being equaled or exceeded in any given year, commonly known as the 100 year flood plain, as determined by reference to the Maps, 350 CMR 11.07.

Generate or Generation of Pollutants means the origination, creation or production of Pollutants.

Ground water means water below the land surface in a saturated zone, including perched ground water.

Hazardous Material or Waste means any material or waste, in whatever form, which because of its quantity, concentration, corrosivity, flammability, reactivity, toxicity, or infectious, chemical or radioactive characteristics, either separately or in combination with any substance or substances, constitutes a present or potential threat to human health, safety, welfare, or to the environment. Hazardous Material or Waste shall include those materials listed in 40 CFR 261, or 310 CMR 40.900 Appendix I.

Impervious means not allowing entrance or passage of water due to the presence on or above the ground of material having a percolation rate of greater than 30 minutes per inch, including, but not limited to, pavement, concrete, stone, peat, loam and other organic matter.

Leaching Field means a soil absorption system as such term is defined in Title 5 (350 CMR 15.00).

List of Affected Parcels means the list developed by the Division from maps prepared pursuant to M.G.L. c. 92 107A(q).

Lot means an area of land subject to St. 1992 c. 36 in one ownership with definite boundaries described in a deed or shown on a plan recorded in the registry of deeds or registered in the registry district of the land court.

Maps means the maps described in 350 CMR 11.07.

Majority means more than half of the members of any body making a decision pursuant to 350 CMR 11.00.

Natural Basin means an area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water; the catchment area or drainage basin from within which the waters of a stream or stream system are drawn.

Owning an Interest in Real Property or Real Property Interest means having alone, or jointly or severally with others:

- (a) legal title to real property;

11.03: continued

(b) the care, charge or control of real property in any capacity including, but not limited to as agent, executor, executrix, administrator, administratrix, trustee, or guardian of the estate of the holder of legal title;

(c) lessee under a written lease; or

(d) an agent, trustee or other person appointed by the Courts of the Commonwealth.

Papers means all requests, documents, papers, notices, appeals and other written communications permitted or required by the regulations to be filed with the Division or the Commission.

Party Aggrieved means any Person who, because of an act or failure to act by the Division or the Commission under St. 1992 c. 36 or 350 CMR 11.00, may suffer an injury in fact which is different, either in kind or magnitude, from that suffered by the general public, and which is within the scope of the interests identified in St. 1992 c. 36. Such party must specify, in writing, sufficient facts to allow the Division or the Commission to determine whether or not the party is, in fact, aggrieved.

Person means an individual, partnership, corporation, firm, association or group, including a city, town, county, the Commonwealth or other governmental unit owning property or carrying on an activity regulated by St. 1992 c. 36.

Plans means such data, maps, engineering drawings, calculations, specifications, schedules and other materials, if any, deemed necessary by the Division to describe the Lot, portion of the Lot or the Alteration to determine the applicability of St. 1992 c. 36 or to determine the impact of the Alteration upon the interests identified in St. 1992 c. 36.

Pollutant means any substance, man-made or resulting from human activities, that can alter the biological, chemical, physical, or radiological character of water.

Reservoir means either the Wachusett or the Quabbin Reservoir.

Sewage Treatment Facility means any wastewater treatment facility used for treating, neutralizing or stabilizing sewage, including: treatment or disposal plants; the necessary intercepting outfall and outlet sewers; pumping stations integral to such facilities; and equipment and appurtenances related to the foregoing.

Sewer System means pipelines or conduits, pumping stations, force mains, and all other structures, devices, appurtenances, and facilities used for collecting and conveying wastes to a site or works for treatment or disposal.

Storage means the actual or intended containment on a temporary basis or permanent basis which does not constitute Disposal.

Structure means a combination of materials assembled at a fixed location to give support or shelter, such as, but not limited to, a Dwelling, a building, framework, retaining wall, tent, reviewing stand, platform, bin, fence over six feet high, sign, flagpole, recreational tramway, mast for radio antenna or the like. The word "structure" shall be construed, where the context requires, as though followed by the words "or part or parts thereof."

Subsurface Waste Water Disposal System means an on-site subsurface sewage disposal system as defined in Title 5 (310 CMR 15.00).

Surface Water(s) means water in the Watersheds, including any lake, spring, impoundment, and pond, as determined by reference to the Maps, 350 CMR 11.07. Surface water shall include the land located thereunder and the Banks thereto. Surface water shall exclude all Reservoirs, Tributaries, Aquifers, Ground waters, and

man-made farm ponds used for irrigation, as well as so-called great ponds of the Commonwealth which do not drain into a Tributary or a Reservoir.

Title 5 means Title 5 of the Massachusetts Environmental Code governing standard requirements for the siting, constructing, repair, replacement and maintenance of on-site sewage treatment and disposal systems, 310 CMR 15.00.

Treatment means any method, technique, or process, including neutralization, incineration, stabilization or solidification, designed to change the physical, chemical or biological character or composition of any Hazardous Material or Waste so as to neutralize such Material or Waste or so as to render such Material or Waste less hazardous, non-hazardous, safer to transport, amenable to storage, or reduced in volume, except such method or technique as may be included as an integral part of a manufacturing process at the point of generation.

Tributary means a body of running water, including a river, stream, brook and creek, which moves in a definite channel in the ground due to a hydraulic gradient and which flows ultimately into a Reservoir in the Watersheds or the Ware River above the Ware River intake, as determined by reference to the Maps, 350 CMR 11.07. A Tributary shall include the land over which the water therein runs and the Banks thereto.

Uses and Activities means those uses and activities described in M.G.L. c. 92, 107A(a) and (b)(2) and 350 CMR 11.04(3).

Variance Decision means the written decision issued by the Division pursuant to 350 CMR 11.06(3)(g).

Waters of the Watershed System means all waters that in their natural course would flow into the Ware River above the Colbrook Diversion, the open channel of the Wachusett Aqueduct, the Quabbin, Wachusett, Sudbury and Foss reservoirs and any other lake, pond, reservoir, aqueduct, stream, ditch, watercourse or any other open water under the provision of M.G.L. c. 92, 109.

Watershed Reservation(s) means land within the Watershed System and described in St. 1972 c. 737 as amended by St. 1990 c. 436.

Watershed(s) means the Natural Basin from within which water drains or in the natural course would drain into the Quabbin Reservoir, the Wachusett Reservoir, or the Ware River upstream of the Ware River intake.

Watershed System means:

(a) all real and personal property interests held by or on behalf of the Commonwealth immediately prior to the effective date of St. 1992 c. 36 in and for the Metropolitan District Commission water system which were part of or appurtenant to the Quabbin Watershed, Quabbin Reservoir, Ware River Watershed, Wachusett Watershed, Wachusett Reservoir, North and South Sudbury watersheds, Sudbury Reservoir, Framingham Reservoirs 1, 2 and 3, Blue Hills Reservoir, Bear Hill Reservoir, Spot Pond Reservoir, Fells Reservoir, Weston Reservoir, Norumbega Reservoir, Chestnut Hill Reservoir, including land, easements, buildings, structures, all equipment, machinery, vehicles and appliances, improvements, water rights and rights in source of water supply; and

(b) all enlargements and additions to the former Metropolitan District Commission water system acquired or constructed by the Division for the purpose of the Watershed System, including land, easements, buildings, structures, equipment, machinery, vehicles, and appliances, improvements, reservoirs, dams, water rights and rights in sources of water supply, but excluding the Waterworks System of the Authority.

Waterworks System means waterworks system as defined in M.G.L. c. 92 App. and 360 CMR 10.00 et seq.

Wetlands Protection Act means the Wetlands Protection Act, M.G.L. c. 131, 40 and regulations promulgated pursuant thereto, 310 CMR 10.00 et seq.

11.04: Jurisdiction

(1) Areas Regulated. Areas regulated by St. 1992 c. 36 and 350 CMR 11.00 include those portions of the Watersheds which lie:

- (a) within 400 feet of the Bank of a Reservoir;
- (b) within 200 feet of the Bank of a Tributary or Surface Waters;
- (c) within the area between 200 and 400 feet of the Bank of a Tributary or Surface Waters;
- (d) within the Flood plain of a Tributary or Surface Waters, including that flood plain;
- (e) within Bordering Vegetated Wetlands that border on Tributaries or Surface Waters or Reservoirs;
- (f) within land that overlays an Aquifer with a potential well yield of 100 gallons per minute or more as determined in accordance with St. 1992 c. 36 and 350 CMR 11.00; or
- (g) within land that overlays an Aquifer with a potential well yield of one or more but less than 100 gallons per minute pursuant to a finding by the Division, in consultation with the Department, that regulation of said Aquifer is necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs or Tributaries.

(2) Presumptions - Properties Identified in the List of Affected Parcels. For purposes of 350 CMR 11.00, all properties identified in the List of Affected Parcels shall be presumed to be in an area regulated under 350 CMR 11.04(1)(a) through (g). Any property which is not identified in the List of Affected Parcels shall be presumed not to be in an area regulated under 350 CMR 11.04(1)(a) through (f).

(3) Uses and Activities Regulated or Prohibited.

(a) Any Alteration, or the Generation, Storage, Disposal or Discharge of Pollutants is prohibited within those portions of the Watershed that lie:

- 1. within 400 feet of the Bank of a Reservoir (350 CMR 11.04(1)(a)); or
- 2. within 200 feet of the Bank of a Tributary or Surface Waters (350 CMR 11.04(1)(b)).

(b) 1. Within those portions of the Watershed that lie:

- a. within the area between 200 and 400 feet of the Bank of a Tributary or Surface Water (350 CMR 11.04(1)(c));
- b. within the Flood plain of a Tributary or Surface Water (350 CMR 11.04(1)(d));
- c. within Bordering Vegetated Wetlands that border on Tributaries or Surface Waters or Reservoirs (350 CMR 11.04(1)(e));
- d. within land that overlays an Aquifer with a potential well yield of 100 gallons per minute or more as determined in accordance with St. 1992 c. 36 and 350 CMR 11.00 (350 CMR 11.04(1)(f)); or
- e. within land that overlays an Aquifer with a potential well yield of one or more but less than 100 gallons per minute, pursuant to a finding by the Division, in consultation with the

Department, that regulation of said Aquifer is necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs or Tributaries (350 CMR 11.04(1)(g)),

2. the following uses are prohibited:

- a. the Disposal of Pollutants from either privately or publicly owned Sewage Treatment Facilities;
- b. the placement of the Leaching Field of a Subsurface Waste Water Disposal System less than four feet above the maximum water table level as measured at the time of annual high water;
- c. the storage of liquid petroleum products of any kind; provided, however, that an end user of such product, such as a resident in connection with normal residential use or a person responsible for supplying heat to a residence, may store a reasonable volume of such material so long as such storage is in a free standing container inside of the Structure, which Structure shall include at a minimum a foundation thereof with a poured cement slab floor or a concrete reservoir of sufficient volume to hold 125 percent of the tank's capacity;
- d. the Treatment, Disposal, use, generation or Storage of Hazardous Material or Waste, except a reasonable volume of Hazardous Material or Waste incidental to normal residential use;
- e. the Storage and the Disposal of solid waste other than a reasonable volume incidental to normal residential use;
- f. the outdoor Storage of road salt or other de-icing chemicals; provided, however, that 350 CMR 11.00 shall not prohibit the outdoor Storage of sand, gravel or materials used in road construction which are not Hazardous Materials or Waste;
- g. the outdoor Storage of fertilizers, herbicides and pesticides;
- h. the use or Storage of pesticides or herbicides which carry a mobility rating as provided for by the United States Environmental Protection Agency or which have been determined by the Commonwealth using United States Environmental Protection Agency standards to pose a threat or potential threat to Ground water;
- I. the outdoor, uncovered Storage of manure;
- j. the servicing, washing or repairing of boats or motor vehicles other than as reasonably incidental to normal residential use;
- k. the operation of junk and salvage yards;
- l. the rendering Impervious of more than ten percent of any Lot or 2,500 square feet, whichever is greater;
- m. the excavation of gravel and sand to a depth greater than six feet above the maximum water table, except where incidental to the construction of permitted Structures;
- n. the Alteration of Bordering Vegetated Wetlands;
- o. any other activity which could degrade the quality of the water in the Watersheds as determined by the Division after consultation with the Department; provided, however, that de-icing may be performed on a roadway under procedures approved by the Commonwealth's Secretary of Environmental Affairs; or

p. the construction of any Dwelling which exceeds a density of two bedrooms per acre or any use which may generate more than 220 gallons of sanitary sewage per acre per day.

(c) In addition to, and without limiting, the prohibitions contained in 350 CMR 11.04(3)(a) and (3)(b), within those portions of the Watersheds which overlay Aquifers with potential well yields of between 100 and 300 gallons per minute as determined by the Division, or land whose regulation has been determined to be necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs and Tributaries, pursuant to 350 CMR 11.04(1)(g), the construction of any Dwelling which exceeds a density of one and one-third bedrooms per acre and any use which may generate more than 147 gallons of sanitary sewage per acre per day are prohibited.

(d) In addition to, and without limiting, the prohibitions contained in 350 CMR 11.04(3)(a), (3)(b) and (3)(c), within those portions of the Watersheds that overlay Aquifers with potential well yields of over 300 gallons per minute as determined by the Division, the construction of any Dwelling which exceeds a density of one bedroom per acre and any use which may generate more than 110 gallons of sanitary sewage per acre per day are prohibited.

(e) In making the calculation required under 350 CMR 11.04(3)(b)2.l. all contiguous real property within an area described in 350 CMR 11.04(1) owned by the same Person shall be used, in the aggregate; provided, however, that said area may be so used in making such calculation for only one Lot.

(f) In making the calculation required under 350 CMR 11.04(3)(b)2.p., all contiguous real property within an area described in 350 CMR 11.04(1) owned by the same Person shall be used, in the aggregate, to determine the total acreage for density purposes; provided, however, that said area may be so used for determining area density for only one Lot.

11.05: Exemptions

The provisions of 350 CMR 11.04 shall not apply to the following:

(1) Uses, Structures or Facilities in Existence. Uses, Structures or facilities lawfully in existence or for which all applicable municipal, state and federal permits and approvals, other than building permits and permits for septic systems, were obtained prior to July 1, 1992;

(2) Reconstruction, Extension or Structural Change. Any reconstruction, extension or structural change to any Structure lawfully in existence on July 1, 1992, provided that such reconstruction, extension or structural change:

(a) does not constitute a substantial change to or enlargement of that lawfully existing Structure; and

(b) does not degrade the quality of the water in the Watershed;

(3) Lot in Existence. The construction of one single-family Dwelling on any Lot existing as such prior to July 1, 1992, or the division of an owner occupied Lot existing as such as of July 1, 1992 into one additional Lot for a single family dwelling; provided that, wherever possible, there shall be no Alterations within the areas described in 350 CMR 11.04(1)(a) and 11.04(1)(b);

(4) Construction - Sewer System. The construction of any Dwelling described in 350 CMR 11.04(3)(b)2.p., 11.04(3)(c) or 11.04(3)(d) if a Sewer System existed prior to July 1, 1992 to which a direct connection shall be made without expansion of capacity and said connection is used for all sanitary sewage of any Dwelling or other Structure resulting from said construction;

(5) Tributaries. Tributaries, or portions thereof, which the Division, in consultation with the Department, has exempted pursuant to 350 CMR 11.00, upon a determination that such exemption will pose no significant risk to the quality of the water, after taking into account the rate of flow, slope, soil characteristics, proximity to a

Reservoir or the Ware River above the Ware River intake, the current level of water quality and the current degree of development;

(6) Work of the Division. The Division, in the performance of its responsibilities and duties to protect the quality of the water in the Watersheds, or the Authority in the performance of its responsibilities and duties to maintain, operate and improve the Waterworks System;

(7) Conversion of Land for Agricultural Use. Conversion of Land for Agricultural Use or preparation of Land for Agricultural Use; provided, however, that such conversion shall be made under a plan approved by the United States Department of Agriculture, Soil Conservation Service and the Commission, in consultation with the Commonwealth's Department of Food and Agriculture;

(8) Maintenance of Public Roadways in Existence. The maintenance, repair, replacement or reconstruction of public roadways existing as of September 1, 1989 or railroad track and rail bed existing as of September 1, 1990, including associated drainage systems, that are necessary to preserve or restore the facility's serviceability for the number of travel lanes and uses existing as of September 1, 1990; provided, however, that in the case of any replacement the design is substantially the functional equivalent of, and is of similar alignments to that which is being replaced; provided, further, that design plans and specifications for said work on roadways, or railroad track and rail beds are provided to the Division prior to the work's commencement;

(9) Maintenance or Improvement - Agricultural. Activities relating to normal maintenance or improvement of Land in Agricultural Use; provided, however, that such activities do not impair the quality of the water;

(10) Construction of Public Highways. The construction of public highways, railroad track and rail beds and facilities directly related to their operation; provided, that the Commonwealth's Secretary of Environmental Affairs has determined that such highway or transportation service construction project requires direct access to or location in the lands described in 350 CMR 11.04(1) to avoid or minimize damages to the environment and that said Secretary and the Division have determined that such construction does not materially impair the quality of the water in the Watersheds;

(11) Maintenance of Public Utilities. The maintenance, repair or expansion of lawfully located Structures or facilities used in the service of the public to provide electric, gas, water, sewer, telephone, telegraph and other telecommunication services; provided, however, that such maintenance, repair or expansion activities, Structures, or facilities do not materially impair the quality of water in the Watersheds as determined by the Division after consultation with the Department;

(12) Maintenance of Public Utilities - Wetlands. The maintenance, repair or replacement, but not the substantial changing or enlargement of, an existing and lawfully located Structure or facility used in the service of the public and used to provide electric, gas, water, sewer, telephone, telegraph and other telecommunication services in Bordering Vegetated Wetlands; provided, however, that such maintenance and repair activities do not materially impair the quality of water in the Watersheds;

(13) Clean up or Prevention of Releases. The undertaking by any Person, municipality, the United States government or the Commonwealth of temporary operations to clean up, prevent or mitigate releases of Hazardous Material or Waste;

(14) Changes in Agricultural Crops Produced. Changes in agricultural crops produced;

(15) Agricultural Technologies. The use of new or existing agricultural technologies that do not degrade the quality of water in the Watersheds more than the present agricultural technologies that such new or existing agricultural technologies replace; and

(16) Municipal Sewage Treatment Facility or Water System. The construction of a new municipal Sewage Treatment Facility or new municipal water system if the Division determines that water quality will not be

adversely impacted from said construction and provided that such new systems comply with all existing regulations and standards applicable to water pollution abatement districts.

11.06: Procedures

(1) Advisory Rulings

(a) *Request for Advisory Ruling.* Any person Owning an Interest in Real Property may, by written request to the Division at the addresses specified in 350 CMR 11.11 by certified mail or hand delivery, request an Advisory Ruling as to:

1. whether such Person's property is located within an area regulated by St. 1992 c. 36 or 350 CMR 11.00; or
2. whether existing or proposed Structures, Uses or Activities on such Person's property are permitted under St. 1992 c. 36 or 350 CMR 11.00 by virtue of the exemptions set forth in 350 CMR 11.05.

(b) *Information Required.* Such written request shall identify the property by street address and include:

1. a copy of the current Assessor's Map showing the location of the property or reference to the applicable Assessor's Map by sheet and parcel number;
2. a copy of (or reference to) the most recent edition of the Massachusetts Geographic Information System map based on the United States Geological Survey, 1 to 25,000 scale, quadrangle maps, showing the location of the property;
3. a copy of such Owner's deed as recorded in the applicable registry of deeds; and
4. copies of any plans, mortgage inspection plans and tape surveys of the property which are available.

(c) *Issuance of Advisory Ruling.* Within 30 days of the Date of Submission of a request for Advisory Ruling, the Division may issue a written ruling to the Person who submitted the request, or in its sole discretion, the Division may notify such Person that a request for Watershed determination of applicability is required pursuant to 350 CMR 11.06(2).

(d) *Remedy.* The Person to whom an Advisory Ruling is issued shall have no right to appeal such ruling, but may at such Person's election, submit a request for Watershed determination of applicability or an application for variance in accordance with 350 CMR 11.00. A Person who has not been issued an Advisory Ruling within 30 days may, at such Person's election, resubmit the request, or submit a request for Watershed Determination of Applicability or an application for variance in accordance with 350 CMR 11.06.

(e) *Authorization; limitations.* Any Advisory Ruling hereunder shall be issued by the Division pursuant to and subject to the limitations of M.G.L. c. 30A, 8.

(2) Requests for Watershed Determinations of Applicability

(a) *Filing.* Any Person Owning an Interest in Real Property who desires a determination as to whether or not:

1. such Person's property is located within an area regulated by St. 1992 c. 36 or 350 CMR 11.00;
2. proposed Structures, Uses or Activities on such Person's property are permitted under St. 1992 c. 36 or 350 CMR 11.00;

3. a reconstruction, extension or structural change constitutes a substantial change or enlargement or one which will degrade the quality of water under 350 CMR 11.05(2);
4. Alterations within areas described in 350 CMR 11.04(1)(a) and 11.04(1)(b) in connection with construction permitted under 350 CMR 11.05(3) are possible;
5. the maintenance, repair or replacement activities described in 350 CMR 11.05(9), (10) or (11) will impair or materially impair the quality of the water in the Watersheds; or
6. a new municipal Sewage Treatment Facility or new municipal water system will have an adverse impact on water quality under 350 CMR 11.05(16),

may submit to the superintendent of the Reservoir of the Watershed in which such property is located at the address specified in 350 CMR 11.11, by certified mail or hand delivery, a request for Watershed determination of applicability (See 350 CMR 11.13).

(b) *Land Surveyor Determination.* Any request for Determination under 350 CMR 11.06(2)(a)1. shall be accompanied by a written determination of a land surveyor registered with the board of registration of professional engineers and land surveyors of the Commonwealth as to whether such Person's real property interests are located within areas regulated by St. 1992 c. 36.

(c) *Related Statement.* Requests for Watershed Determinations other than those in 350 CMR 11.06(2)(a)1. shall include a detailed description of the Structures, Uses and Activities which are proposed.

(d) *Additional Materials.* All surveys and additional materials or studies required to make a determination, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person desiring the determination.

(e) *Issuance of Applicability Decision.* Within 60 days of the Date of Submission of such request for Watershed Determination, the Division shall issue a written Applicability Decision to the Person who submitted such request, in form suitable for recording in the registry of deeds or registration in the registry district of the land court where the property is located (See 350 CMR 11.13), which shall contain a brief statement of the reasons for the Decision. If the Division fails to issue the Applicability Decision within such 60 day period, the Division shall be deemed to have:

1. concurred with the land surveyor's determination set forth in a request for Determination under 350 CMR 11.06(2)(a)1.; or
2. determined that the proposed Structures, Uses and Activities on such Person's property described in the request for Determination are permitted by St. 1992 c. 36 and 350 CMR 11.00; or
3. determined that such Structures, Uses and Activities will not impair or materially impair the quality of water in the Watersheds.

(f) *Appeal.* A Person to whom the Division's Applicability Decision has been issued, who seeks to appeal such Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

(3) Variances

(a) *Variances.* The Division may grant a variance from the provisions of St. 1992 c. 36 and 350 CMR 11.00 with respect to particular Structures, Uses and Activities, and shall grant, upon request, a variance with respect to crossings of Tributaries and Bordering Vegetated Wetlands, where the Division specifically finds that owing to circumstances relating to the soil conditions, slope, or topography of the land affected by such Structures, Uses or Activities, desirable relief may be granted without substantial detriment to the public good and without impairing the quality of water in the Watersheds.

(b) *Presumptions and Standards for Required Findings.*

1. There shall be a presumption that granting a variance from the applicability of St. 1992 c. 36 and 350 CMR 11.00 to specific Structures, Uses and Activities is contrary to the achievement of the purpose of St. 1992 c. 36. This presumption may be rebutted only by the submission of credible evidence by the Person submitting the application for variance to establish that such variance may be granted without substantial detriment to the public good and without impairment of water quality in the Watersheds.

2. The standard of substantial detriment to the public good shall mean a factual determination by the Division of the overall effect of the proposed Structure, Use or Activity at a particular location in relation to the purpose of St. 1992 c. 36.

3. The standard of impairment of water quality shall mean:

- a. the risk of water quality impairment presented by Structures, Uses and Activities which are permissible under all other relevant federal, state and local laws, but would not be permissible under 350 CMR 11.00 without a variance; and
- b. the cumulative risk of water quality impairment from all Structures, Uses and Activities allowed under current regulations over time.

(c) *Applications.* Any Person Owning an Interest in Real Property may make an application for variance to the Division (See 350 CMR 11.13) by filing the same by certified mail or hand delivery with the Division at the address specified in 350 CMR 11.11. A copy of the application for Variance shall be sent to the Department at the address specified in 350 CMR 11.11.

(d) *Detailed Statement.* The application for variance shall include a detailed description of the Structures, Uses and Activities proposed on such Person's property. The application for variance shall include detailed information regarding each specifically enumerated factor stated in 350 CMR 11.06(3)(a). Detailed information regarding each factor shall be provided as follows:

1. *Soil Conditions.* A map prepared at a minimum scale of 1"=100' indicating the soil types as mapped by the USDA Soil Conservation Service ("SCS") shall be provided. Site specific soils data, including borings, test pits and percolation tests, may be submitted including copies of all field logs, notes, observations, conclusions and test methods employed. A detailed analysis of the soil characteristics of erodibility and permeability shall be provided. Permeability should be described in terms of percolation rate measured as minutes per inch as specified in Title 5 (310 CMR 15.00).

2. *Slope.* Calculations of the ground slope at all lands within the areas that would be subject to St. 1992 c. 36 if the variance were not granted shall be provided. The results of such calculations shall be presented graphically on a map prepared at a scale of 1"=100' or larger, expressed as percent slope. Where applicable, the average slope of a Tributary measured as the change in elevation divided by the distance in stream miles from the upstream point of the Tributary at or near such Person's property to the downstream point of the Tributary at or near such Person's property shall also be stated.

3. *Topography.* A topographical plan at a minimum scale of 1"=100' or larger showing contour elevations at two foot intervals shall be submitted. Said plan shall be prepared and stamped by a professional surveyor or engineer registered in the Commonwealth of Massachusetts and shall show the location of all areas which would be subject to St. 1992 c. 36 if the variance were not granted. The plan shall show the location of all Ground water, soil and percolation test locations. Such topographic information as depth to the maximum annual high Ground water table, depth to ledge or refusal, and distances from all mapped and unmapped streams, ponds and water bodies shall also be provided.

4. *Water Quality.* The application shall include a detailed analysis of the impacts on Surface Water and, where applicable, Ground water quality of any proposed Structure, Use or Activity which would be allowed if the variance is granted. An evaluation of the potential impact of such proposed Structure, Use or Activity on water quality by reference to the Department's Surface Water Quality Standards for Class A Surface Waters and Outstanding Resource Waters of the Commonwealth, set forth in 314 CMR 4.00 *et seq.*, and/or where applicable, the Massachusetts Ground Water Quality Standards, set forth in 314 CMR 6.00 *et seq.* shall be provided. The application shall include the water quality data and results to support each analysis and shall provide a detailed description of any methodology employed in performing such analysis to show that water quality will not be impaired by the Structure, Use and Activity for which the variance is being requested, whether during construction or upon continued use or operation of such Structure, Use or Activity.

5. *Mitigating Measures.* The application shall include an analysis of any mitigating measures which will be used which would enable the Division to grant a variance without substantial detriment to the public good and without impairing the quality of water in the Watersheds.

(e) *Additional Materials.* All surveys and additional materials or studies required to act on an application for variance, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person submitting the application.

(f) *Public Hearing.* Within 30 days of the Date of Submission of the application for variance with the Division, the Division shall hold a public hearing. Notice of the time and place of the public hearing shall be given by the Division, at the expense of the Person who submitted the application, not less than five days prior to such hearing by publication in a newspaper of general circulation in the city or town where the property in question is located and by mailing a copy of such notice to the Person who submitted the application at the address specified in the application, and to the Building Inspector, Conservation Commission, and Board of Health in such city or town. At the request of the Person who submitted the application filed with the Division at least two days before the date of such hearing, the date of the hearing may be rescheduled to a time which is mutually convenient for such Person and the Division, provided that such rescheduled time shall permit re-publication of notice as provided herein.

The public hearing may be continued, with the consent of the Person who submitted the application, to an agreed upon date, which shall be announced at the hearing. At the public hearing, such Person may be represented by counsel and/or professional consultants and may present oral or written evidence and oral or written testimony of witnesses.

(g) *Variance Decision.* Within 30 days of the close of the public hearing, the Division shall issue a written Variance Decision on the application for variance. If the variance is granted, the Division may impose in the Variance Decision such reasonable conditions, safeguards and limitations as it may find desirable in its sole discretion, which, based on the application for variance and the evidence presented at the public hearing, are necessary to protect the water in the Watersheds. If a variance is denied, the Variance Decision shall contain a brief statement of the reasons for the denial. The granting of a variance is limited to the provisions of St. 1992 c. 36. All other applicable laws, regulations and ordinances shall not be affected by the granting of a variance.

(h) *Recording of Variance Decision.* No variance granted hereunder shall take effect until a Variance Decision (See 350 CMR 11.13) shall have been recorded and indexed in the grantor index in the registry of deeds or registered in the registry district of the land court for the county or district where the property is located, containing any conditions applicable thereto and describing the land by metes and bounds or by reference to a recorded or registered plan showing the property's boundaries.

(i) *Appeal.* A Person to whom a Variance Decision is issued, who seeks to appeal the Division's Variance Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Variance Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

(4) Exemption of a Tributary

(a) *Exemption of a Tributary.* The Division, in consultation with the Department, may exempt a Tributary, or portions thereof, upon a determination that such exemption will pose no significant risk to the quality of water, after taking into account the following factors:

1. rate of flow;
2. slope;
3. soil characteristics;
4. proximity to a Reservoir or the Ware River above the Ware River intake;
5. the current level of water quality; and
6. the current degree of development.

(b) *Presumptions and Standards for Required Findings.*

1. The standard of no significant risk to the quality of water refers to:
 - a. the risk of water quality impairment presented by Structures, Uses and Activities which are permissible under all other relevant state, federal and local laws, but would not be permissible under 350 CMR 11.00 without an exemption; and
 - b. the cumulative risk of water quality impairment from all Structures, Uses and Activities allowed under current regulations over time.
2. There shall be a presumption that exempting a Tributary or portion thereof is contrary to the achievement of the purpose of St. 1992 c. 36. The presumption may be rebutted only by the submission of credible evidence by the Person submitting the request for Exemption to establish that such exemption will pose no significant risk to the quality of water, taking into account the factors enumerated at 350 CMR 11.06(4)(a).

(c) *Requests for Exemption.*

1. A request for Exemption of a Tributary may be made by:
 - a. An affected landowner;
 - b. Any state agency or regional planning commission;
 - c. The Board of Selectmen, City Council, Mayor, Planning Board or Conservation Commission of any city or town which would be affected by the exemption; or
 - d. The Governor or any member of the General Court.

2. A request for Exemption of a Tributary shall be made to the Division (See 350 CMR 11.13) by filing the same by certified mail or hand delivery with the Division at the address specified in 350 CMR 11.11. A copy of the request for Exemption of a Tributary shall be sent to the Department at the address specified in 350 CMR 11.11.

(d) *Detailed Statement.* The request for Exemption of a Tributary shall include detailed information regarding each specifically enumerated factor listed in 350 CMR 11.06(4)(a)1. through 6. Such detailed information shall be provided based on conditions existing as of the time of the request and based on conditions which would, or may, result if such exemption were granted and if development occurred to the maximum extent and type allowed by current law. Detailed information on each factor shall be provided as follows:

1. *Flow Rate.* The request shall include the flow rate of the Tributary stated as the annual average daily stream flow, reported as cubic feet per second ("cfs") as measured at the downstream point of discharge for the Tributary or portion thereof, taking into account the entire contributing drainage area. Such flow rate may be based on field data collected in accordance with accepted stream flow measurement methods as established by the United States Geologic Survey, or estimated based on procedures established by the United States Geologic Survey. The request shall describe, in depth, the basis and method employed for the reported flow rate to assess full build-out scenarios.

2. *Slope.* The request shall state the average slope at the Tributary measured as the change in elevation divided by the distance in stream miles from its source to the downstream point of discharge. The ground slope of all lands adjacent to the Tributary within the areas that would be subject to St. 1992 c. 36 if the exemption were not granted shall be calculated and the results of such calculations shall be presented graphically on a map prepared at a scale of 1"=100' or larger, expressed as percent slope.

3. *Soil Characteristics.* A map prepared at a minimum scale of 1"=100' shall be submitted indicating the soil types as mapped by the SCS. Site specific soils data supporting or contradicting the SCS soil mapping including borings, test pits and percolation tests may be submitted including copies of all field logs, notes, observations, conclusions and test methods employed. A detailed analysis of the soil characteristics of erodibility and permeability shall be provided. Permeability should be described in terms of a percolation rate measured as minutes per inch as specified in Title 5 (310 CMR 15.00).

4. *Proximity to a Reservoir or the Ware River above the Ware River Watershed.* Proximity of the Tributary proposed to be exempted to a Reservoir or the Ware River above the Ware River intake shall be indicated by reference to the Protection Zone, defined by the Department's Division of Water Supply, Watershed Resource Protection Plan Policy as Zone A, Zone B and Zone C. The measured distance in stream miles from the downstream discharge point of the Tributary or portion thereof in question from that Tributary's ultimate point of confluence with a Reservoir or stream miles above the Ware River intake shall be stated.

5. *Water Quality.* The request shall include water quality monitoring data for the Tributary consisting of, at a minimum, monthly samples for a continuous one year period at a sampling station located at or near the downstream point of discharge of the Tributary or portion thereof for which exemption is requested. Water quality data of the Division and the Department may be utilized in satisfaction of this requirement where such data is available. Minimum analysis shall include fecal coliform bacteria, color, turbidity, temperature, pH, dissolved oxygen, total suspended solids, total phosphorus, ammonia nitrogen and chloride. A detailed analysis of the water quality data with reference to the Department's Surface Water Quality Standards for Class A Surface Waters and Outstanding Resource Waters of the Commonwealth, 314 CMR 4.00 et seq., shall be provided. The request shall include a detailed analysis of the impact on water quality of any potential Structures, Uses or Activities allowed if the exemption is granted.

6. *Development.* A general plan showing existing land use within the contributing drainage area upstream at the point of discharge of the Tributary or portion thereof shall be provided. The request shall include a calculation of the percent imperviousness of the contributing drainage area based on the existing land uses shown and shall indicate the change of percent imperviousness which may result from any Structures, Uses or Activities allowed or proposed if the exemption is granted.

7. *Other Information.* The request shall include a detailed description of the Structures, Uses and Activities which are or may be proposed to occur within those areas which would be subject to St. 1992 c. 36 without the exemption and shall include an analysis of any mitigating measures which will be used which would ensure that granting the exemption would present no substantial risk to the quality of water.

(e) *Additional Materials.* All surveys and additional materials or studies required to act on a request for Exemption of a Tributary, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person submitting the request.

(f) *Public Hearing.* Within 30 days of the Date of Submission of the request for Exemption of a Tributary with the Division and the Department, the Division and the Department shall hold a public hearing. Notice of the time and place of the public hearing shall be given by the Division, at the expense of the Person who submitted the request, not less than five days prior to such hearing by publication in a newspaper of general circulation in the city or town where the property in question is located and by mailing a copy of such notice to the Person who submitted the request at the address specified in the request, and to the Building Inspector, Conservation Commission and Board of Health in such city or town. At the request of the Person who submitted the request filed with the Division at least two days before the date of such hearing, the date of the hearing may be rescheduled to a time which is mutually convenient for such Person, the Division and the Department, provided that such rescheduled time shall permit re-publication of notice as provided herein. The public hearing may be continued, with the consent of the Person who submitted the request, to an agreed upon date, which shall be announced at the hearing. At the public hearing, such Person may be represented by counsel and/or professional consultants and may present oral or written evidence and oral or written testimony of witnesses.

(g) *Exemption Decision.* Within 60 days of the close of the public hearing, the Division shall issue a written Exemption Decision on the request for Exemption of a Tributary. If the exemption is granted, the Division may impose in the Exemption Decision such reasonable conditions, safeguards and limitations as it may find desirable in its sole discretion, which, based on the request for Exemption of a Tributary and the evidence presented at the public hearing, are necessary to protect the water in the Watersheds. If the exemption is denied, the Exemption Decision shall contain a brief statement of the reasons for the denial. The granting of an exemption is limited to the applicability of St. 1992 c. 36. All other applicable laws, regulations and ordinances shall not be affected by the granting of an exemption.

(h) *Notice of Exemption.* Notice of the Exemption Decision shall be mailed to the Person who submitted the request, and to the City Council or Board of Selectmen in the city or town where the Tributary is located. Notice shall also be published once in a newspaper of general circulation in such city or town, provided, however, that a failure to publish shall not affect the validity of the Exemption Decision. A record of the Exemption Decision shall be kept on file with the Division and, if a Tributary or portion thereof is exempted, the affected area shall be shown on the most recent edition of the Massachusetts Geographic Information System Map (See 350 CMR 11.07).

(i) *Appeal.* A Person to whom an Exemption Decision is issued, who seeks to appeal the Division's Exemption Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Exemption Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

11.06: continued

(5) Work Pending Appeal of Applicability Decision, Variance Decision or Exemption Decision - No Alterations shall be made or Structures, Uses or Activities commenced until a final administrative or judicial determination has been made and all appeal periods shall have expired if the Division issues:

(a) an Applicability Decision that the property is located in an area regulated by St. 1992 c. 36, that the Structures, Uses or Activities proposed are prohibited by St. 1992 c. 36 under 350 CMR 11.04(3), or that the Structures, Uses or Activities will impair or materially impair the quality of water in the Watersheds; or

(b) a Variance Decision denying the variance requested in an application for variance; or

(c) an Exemption Decision denying a request for Exemption of a Tributary.

11.07: Maps

(1) Aquifers. The location and potential well yield of Aquifers shall be determined by reference to the most recent edition of maps generated by the Massachusetts Geographic Information System based on the United States Geological Survey Water Resource Atlases.

(2) Flood plains. The location of Flood plains shall be made by reference to the most recent edition of the Flood Hazard Boundary Maps issued by the Federal Emergency Management Agency.

(3) Surface Waters and Tributaries. The location of Surface Waters and Tributaries shall be determined by reference to the most recent edition of maps generated by the Massachusetts Geographic Information System based on the United States Geological Survey, 1 to 25,000 scale quadrangle maps.

(4) Adoption of More Accurate Maps. With respect to any of the maps referred to in 350 CMR 11.07, the Division, in consultation with the Department, may adopt more accurate maps pursuant to notice and a public hearing as provided by M.G.L. c. 30A. The Division shall file any of such maps which are adopted with the Clerk of the House of Representatives and Clerk of the Senate and such maps shall not take effect until 90 days have elapsed from the time of said filing. Copies of maps which have taken effect shall be filed with the Chief Executive Officers of all cities and towns within the Watersheds, provided that the Division's failure to do so shall not invalidate the maps or any actions taken by the Division in connection therewith.

11.08: Relationship of Act with other State and Municipal Statutes, Ordinances and Regulations

350 CMR 11.00 is intended solely for use in administering St. 1992 c. 36; nothing contained herein should be construed as preempting or precluding more stringent protection of the areas regulated by St. 1992 c. 36 by other statutes, ordinances, by-laws or regulations. The duties and obligations imposed by St. 1992 c. 36 shall be in addition to all other duties and obligations imposed by any general or special law or regulation or any by-law, ordinance or regulation lawfully adopted pursuant thereto.

11.09: General Rules and Regulations for the Protection of Watersheds and the Watershed System

In order to facilitate review of all regulations promulgated by the Commission and the Division relating to Watersheds and the Watershed System, this Section includes regulations of general applicability to Waters of the Watershed System. The regulations in 350 CMR 11.09 are intended to supersede the regulations in 310 CMR 23.00, 350 CMR 8.01, 350 CMR 9.00, and 350 CMR 10.00.

(1) Waters of the Watershed System.

(a) No Person shall take or divert any Waters of the Watershed System of the Commission and no Person shall corrupt, render impure, waste or improperly use any such water.

(b) No Person shall:

1. engage in any construction activity involving filling, dredging, grubbing or altering land without adequate provisions to prevent erosion resulting in clay, silt or other turbidity laden waters from entering the Waters of the Watershed System;
2. construct, establish or maintain any agricultural facility or place where animal manure may be deposited or accumulated without adequate provision to prevent any manure or other Pollutant from flowing or being washed into the Waters of the Watershed System;
3. engage in any other activity which could degrade the quality of Waters of the Watershed System or interfere with their use as a source of water supply.

(c) No Person shall allow a condition to exist on such Person's property which could result in the direct or ultimate discharge of any Pollutant into the Waters of the Watershed System.

(d) Any records of any board of health or health agent concerning matters within the Watershed shall be open to inspection by the employees and agents of the Commission and the Department.

(e) Whenever an incident occurs, is likely to occur, or a situation exists that threatens to add Pollutants to the Waters of the Watershed System, the Person causing or contributing to the pollution or potential pollution shall notify the Commission and the Department immediately.

(2) Watershed System.

(a) General Regulations.

1. Entrance on and exit from land of the Watershed System shall be made through gates or other designated areas.
2. No Person is allowed within any land of the Watershed System, except from one hour before sunrise to one hour after sunset, unless authorized by a written permit from the Commission or its designee.
3. Powered boats are prohibited within the Waters of the Watershed System except in areas designated by the Commission or its designee.
4. All acts which pollute or may pollute the water supply are prohibited. No litter or refuse of any sort may be thrown or left in or on any land or water within any Watershed System. All Persons within said System shall use the sanitary facilities provided for public use.
5. All acts which injure the property of the Commonwealth are prohibited. No Person shall injure, deface, destroy, remove or carry off any property, real or personal, under the care and control of the Commission, including but not limited to, all historic artifacts and natural materials. The removal of gravel, topsoil, stones, boulders, or other earthen material is prohibited from the Watershed System except for removal for official use for land management purposes by Commission staff. No Person shall build or construct any object or structure of the property of the Commonwealth except with the written permission of the Commission or its designee.
6. Cooking and all fires are prohibited within the Watershed System.
7. No Person shall wade or swim in any reservoir except wading while using boots for the purpose of launching boats at designated boat launch areas.

8. No Person shall wade or swim in any Tributary or Surface Waters on or within the property of the Commonwealth except at areas designated by the Commission or its designee.
9. Organized sports activities, including but not limited to orienteering and baseball, are prohibited in the Watershed System except by written permit from the Commission or its designee.
10. Any violation of 350 CMR 11.09 will be deemed sufficient cause for revocation of fishing privileges for a period of time not less than one year from the time of violation. The Commission and its employees are not responsible for any damage to or loss of property sustained by fishermen, or for any injury or loss of life which may be incurred in connection with public use of the reservoirs and Watershed System.
11. Breach of peace, profanity or other disorderly conduct offensive to the general public is strictly prohibited within the Watershed system. Possession of and drinking of alcoholic beverages is prohibited within said System.
12. No Person shall drive a motorized vehicle within the Watershed System except upon roads authorized for such use by the Commission or its designee. Recreational vehicles are prohibited on all Watershed System property except the use of snowmobiles in areas designated by the Commission or its designee. Motor vehicles shall be parked only in areas designated by the Commission or its designee. Operators of motor vehicles shall obey all regulatory signs unless otherwise directed by a police officer or person in charge. No Person shall willfully obstruct the free passage of vehicles or Persons within the Watershed System. Vehicle access for official use may be granted by the Commission or its designee.
13. No Person shall bring any animal within any Watershed System property except for horses and dogs at the Ware River Watershed at areas designated by the Commission or its designee.
14. The use of bicycles, skis and other means of non-motorized transportation within the Watershed system shall be permitted only in areas designated by the Commission or its designee.
15. No Person, except in an emergency, shall bring, land or cause to descend within any Watershed System property any aircraft except with a written permit from the Commission or its designee.
16. Parades, games, fairs, carnivals, fishing derbies, bazaars, gifts or solicitations for raising or collecting funds shall not be permitted within the Watershed System without written approval of the Commission or its designee.
17. Lotteries, raffles, gambling and games of chance are prohibited; and no Person shall have possession of machinery, instruments or equipment of any kind for use of same in the Watershed System.
18. Public assemblies of more than 25 persons shall not be allowed within the Watershed System without a written permit from the Commission or its designee.
19. No Person shall engage in any business, sale or display of goods or wares within the Watershed System without a written permit from the Commission or its designee.
20. Commercial signs and advertising are prohibited in the Watershed System.
21. No Person shall have possession of or discharge any weapon, firearm, fireworks, or other explosive on or within the Watershed System except at times and areas designated by the Commission or its designee. All forms of target shooting are prohibited on or within the Watershed System.

22. No Person may hunt, shoot or trap animals on or within any Watershed System property except at times and in areas designated by the Commission or its designee.

23. All Persons within the Watershed System shall obey the lawful directions of regulatory signs, police officers or persons in charge, or of Federal or Commonwealth wardens or enforcement officers.

24. The Watershed System or parts thereof may be closed for public access at the discretion of the Commission or its designee when necessary to protect the lands and waters under the care and control of the Commission.

25. The possession of all types of metal detectors or similar devices is prohibited on all of the Watershed System property.

(b) Special Regulations for Quabbin Reservoir.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations, will be allowed to fish from shore in areas designated by the Commission or its designee. A valid state fishing or sporting license is required by any Person renting or launching a boat at any Commission facilities subject to 350 CMR 11.09. Reasonable fees for the use of boats, for rental of outboard motors for fishing purposes, or use of Commission facilities including parking and boat ramps, may be charged by the Commission.

2. Persons permitted to fish from boats shall, at all times, be responsible for the sanitary condition of the boats. Persons under 16 years of age must be accompanied by a Person possessing a valid fishing license in order to boat on Quabbin Reservoir.

3. Only boats of a minimum length of 12 feet, and of a type considered safe by the Commission representative in charge, shall be used. No inboard motors, collapsible boats, sailboats, pontoon boats, square sterned canoes, or other similar craft will be permitted in the water, and no boats will be permitted in the water except in areas designated for boating by the Commission or its designee. Outboard motors shall have a rating of not more than one-half the BIA or OBC rated horsepower for the boat and shall not exceed 20 horsepower, except that outboard motors for Commission boats less than fourteen 14 feet six inches in length shall not exceed ten horsepower. Boats less than 14 feet six inches in length will be limited to three occupants, and boats of that length and in excess thereof may be licensed to carry four occupants. No boats shall carry more than four occupants. Canoes and jon boats of a minimum length of 12 feet, and of a type considered safe by the Commission representative in charge, shall be used and only in areas designated for boating by the Commission on Pottapaug Pond above the regulating dam and at Gate 31 above the regulating dam. Canoes less than 16 feet and jon boats less than 14 feet six inches in length will be limited to two occupants, and canoes and jon boats in excess thereof may be licensed to carry three occupants. All boats must be in compliance with current Commonwealth Boating Laws. All boats must be clean and contain no refuse of any kind. Commission personnel shall have the right to inspect all private boats launched at Commonwealth facilities and may deny access in order to protect water quality or the safety of occupants. Chock blocks must be used on vehicles when removing boats from the Reservoir.

4. No Person shall operate a motor boat at a speed other than reasonable and proper or in such a manner as to annoy or endanger the occupants of other boats.

5. Fishing from the shorelines of the Quabbin Reservoir and its Tributaries within the Watershed System or from boats shall be allowed only during a season designated by the Commission or its designee. All privately-owned boats, motors and other equipment must be removed from the property of the Commission each day.

11.09: continued

6. Boats shall not leave the mooring areas before dawn, and must return at the time posted at each mooring area. The beaching of boats at any point except at the designated mooring and landing areas is strictly prohibited, except in cases of extreme emergency.

(c) Special Regulations for Ware River.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish in the Ware River in areas designated by the Commission or its designee.

2. Powered boats and powered canoes are prohibited within the Ware River Watershed Reservation.

(d) Special Regulations for Wachusett Reservoir.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish from the shore of Wachusett Reservoir in areas designated by the Commission or its designee.

2. Boating is prohibited in Wachusett Reservoir.

3. Fishing from the shoreline of the Reservoir shall be allowed only during a season designated by the Commission or its designee.

(e) Special Regulations for Sudbury Reservoir.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish from the shore of Sudbury Reservoir in areas designated by the Commission or its designee.

2. Boating is prohibited on Sudbury Reservoir except in areas designated by the Commission or its designee.

11.10: Enforcement

Any Person who, without lawful authority, takes or diverts any Waters of the Watershed System or corrupts or defiles any such Waters or any source of such Waters or who violates and refuses to comply with any rule, regulation or order of the Commission shall be subject to the fines set forth in M.G.L. c. 92, 111. The provisions of 350 CMR 11.00 shall be enforced upon petition of the Commission or of any town or Person interested by the Supreme Judicial Court or Superior Court or any justice of either court as provided in M.G.L. c. 92, 112. In addition, upon written request by the Division, the Department shall have the authority to enforce the provisions of St. 1992 c. 36 and 350 CMR 11.00 by all legally permitted enforcement mechanisms including, but not limited to: issuing notices of noncompliance; convening pre-enforcement conferences; issuing water supply orders pursuant to M.G.L. c. 111, 160; and imposing administrative penalties pursuant to M.G.L. c. 21A, 16 and 310 CMR 5.00. Such written request by the Division to the Department may seek enforcement for a specified type of violation or area, for a designated group of cases or for an individual matter.

11.11: Miscellaneous

(1) Addresses - Offices of Division

Metropolitan District Commission
Quabbin Reservoir
485 Ware Road
Belchertown, Massachusetts 01007

11.11: continued

Metropolitan District Commission
Wachusett Reservoir
P.O. Box 206
Clinton, Massachusetts 01510

(2) Address of Commission -

Metropolitan District Commission
First Floor
20 Somerset Street
Boston, Massachusetts 02108

(3) Address of Department -

Department of Environmental Protection
Commonwealth of Massachusetts
Regional Division
One Winter Street
Boston, Massachusetts 02108

(4) Access to Property by Division - Any Person making a request for Watershed determination of applicability, an application for variance or a request for Exemption to the Division shall, upon request, allow the Division or its duly authorized representatives to inspect the property in question in order to assist the Division in the determination which is to be made. Personnel of the Division may enter, at reasonable times, any property, public or private, for the purpose of investigating or inspecting any condition relating to the discharge or possible discharge of Pollutants into the Watershed System and may make such tests as may be necessary to determine the existence and nature of such discharge as provided in M.G.L. c. 21, 4.

11.12: Severability

If any provision or any part of 350 CMR 11.00 or the application thereof is held to be invalid, such invalidity shall not affect any other provision of 350 CMR 11.00.

11.13: Forms

Forms for use under the Watershed Protection Act shall be as follows:

Form 1 - Request for Watershed Determination of Applicability

Form 2 - Applicability Decision

Form 3 - Application for Variance

Form 4 - Variance Decision for Recording in Registry of Deeds

Form 5 - Request for Exemption of a Tributary

Forms 1, 3 and 5 and a Guidance Document, which may be of assistance in completing the forms, may be obtained from the Division at the addresses specified in 350 CMR 11.11(1) and (2).

REGULATORY AUTHORITY

350 CMR 11.00: St. 1992, c. 36.

